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GEOLOGICAL SURVEY OF CANADA.

ALFRED R. C. SELWYN, DIRECTOR.

REPORT

ON THE GEOLOGY

OF THE

NORTHWEST SIDE OF LAKE SUPERIOR,

AND OF THE

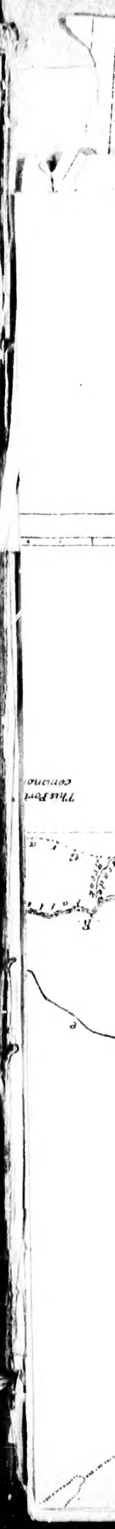
NIPIGON DISTRICT,

BY

ROBERT BELL, C.E., F.G.S.

From the Reports of the Geological Survey of the Dominion of Canada for 1867-69.

DAWSON BROS.: MONTREAL.
B. WESTERMANN & CO.: NEW YORK.
SAMPSON, LOW, SON & MARSTON: LONDON
F. A. BROCKHAUS: LEIPSIC.
BALLIÈRE: PARIS.
1870.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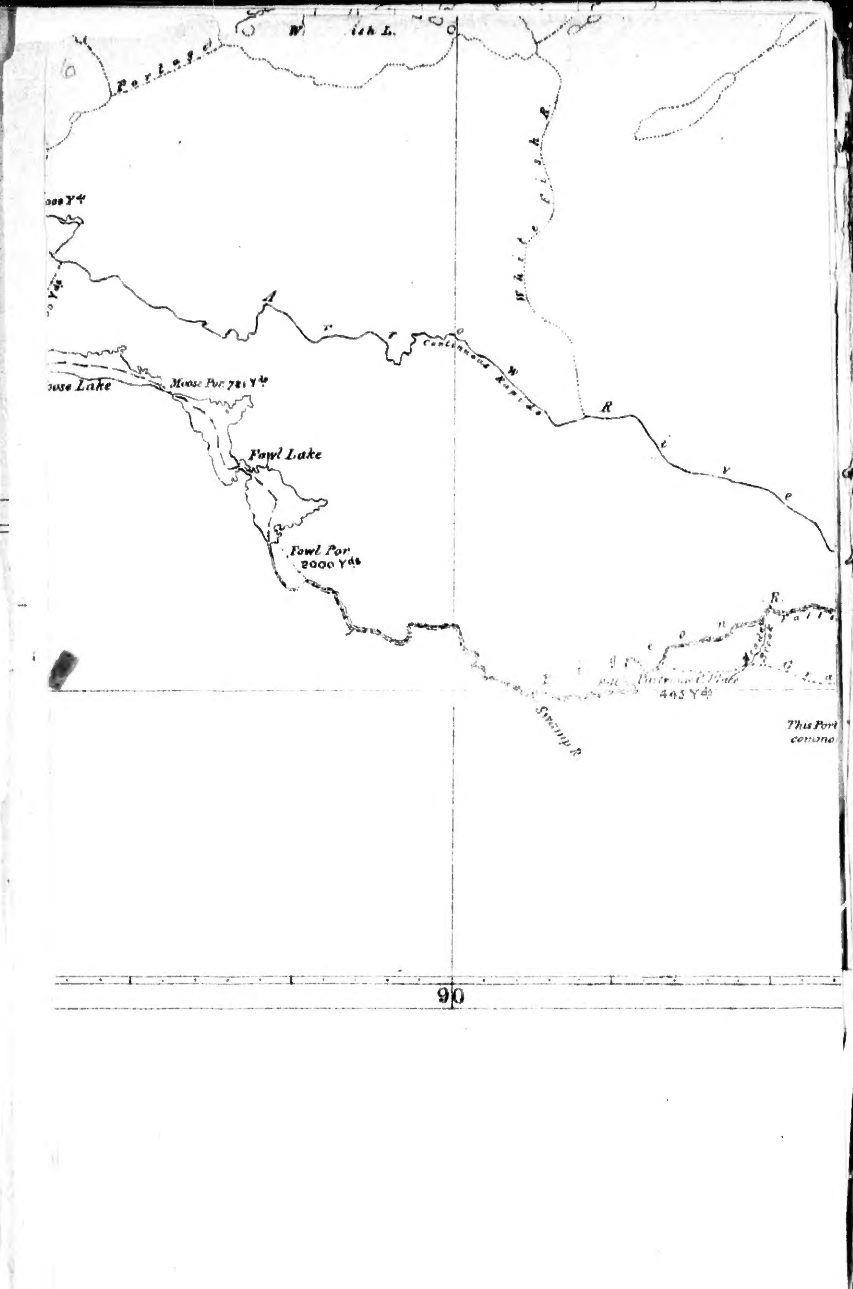
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White Fish R.
Moose Lake
Moose Por. 781 Yds
Fowl Lake
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Pigeon R.
Swamp R.
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REPORT

BY

MR. ROBERT BELL, C.E., F.G.S.,

ADDRESSED TO

ALFRED R. C. SELWYN, ESQ.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

SIR,—I have to report that, in compliance with the instructions which I had the honor to receive from Sir W. E. Logan, I proceeded, in May last, to make a geological examination of the country lying on the north-western side of Lake Superior. Fort William was selected as my head-quarters for the season, from its being the most conveniently situated point for our explorations in the region around Thunder Bay, and from having a post-office, and frequent steamboat communication with the east, and because we could here find safe storage for our provisions and outfit. We were under many obligations to Mr. McIntyre, the gentleman in charge of the Hudson Bay Company's establishment at Fort William, for the accommodation of one of his storehouses, for advice and assistance in procuring proper guides, for the use of boats and canoes, for tracings of various maps in his possession, for much valuable information of all kinds, which his long experience in that region enabled him to give in regard to the country which we examined, and for his kindness and attention generally in promoting the objects of the expedition. We were also greatly indebted to the families of Mr. McIntyre, Mr. McVicar and Mr. McKellar for their kind hospitality whenever any of our party happened to be at Fort William. The officers and employés, generally, of the Hudson Bay Company aided us cheerfully whenever an opportunity occurred. Amongst those from whom we received information or assistance, I may mention Mr. Hopkins of Montreal, Mr. McKenzie of LaCloche, Mr. Bell of Michipicoten, Mr. Charles De La Ronde of Red Rock, Mr. Crawford of Nipigon House, Mr. Henry De La Ronde of Poplar Lodge, Mr. Whyte of Basswood Lake

Acknowledgement, of aid.

and Mr. Pether of Fort Frances. Before starting from Toronto, Mr. Andrew Russell, of the Crown Lands Department, very kindly furnished me with tracings of maps, and with extracts from reports relating to the country to be explored. I am indebted to Mr. Thomas Herrick, P.L.S., for his plan and field-notes of the survey which he made of the Nipigon River; to Messrs. Peter, John and Daniel McKellar for the results of their geological explorations in the country from Pigeon River to Black Bay, and back to a considerable distance beyond Dog Lake, and for numerous topographical features, including a plan of their survey of Current River; also to Mr. H. P. Savigny, P.L.S., of Toronto, Mr. Hugh Wilson, P.L.S., of Mount Forest, Mr. S. J. Dawson, C.E., Mr. W. B. Borron, Inspector of Mines at Fort William, Captain Symes of the steamer Algoma, and Chief Manitousaise of Nipigon, for their kindness in aiding our exploration in various ways. I was assisted in the labors of the season by Messrs. P. McKellar of Fort William, P. B. Ball of Guelph, A. D. Blackader of Brantford, W. Notman of Hamilton, A. McKenzie of Clifton, W. W. Russell of Toronto, C. E. Dobbs of Kingston, and P. McLaren, B.A. of Lanark.

Assistants.

The first month was devoted to an examination of the coast from Prince's Bay to Fort William, the country between this section of the coast and the lower stretch of the Kaministiquia River, the valley of this river, the country between Thunder Bay and Dog Lake, and the shores of Thunder Bay. As required by my instructions, I paid particular attention to the geology of the silver deposits of this region, which promise to be of importance.

Lake Nipigon.

In addition to the district first referred to, I was directed to make an exploration, or if possible, a survey of Lake Nipigon. In tracing the run of the rocks eastward and northward from Thunder Bay, I found that many advantages would be gained by proceeding to this lake as early in the season as possible. By doing so, I hoped to have enough of the summer left to make considerable topographical surveys in that region, which would serve as a correct basis for laying down our geological work. In June last, I had the honor to communicate to Sir William Logan, by letter from Fort William, my reasons for believing that the Huronian and Upper Copper-bearing rocks would be found to occur around Lake Nipigon. In extending our explorations in the region assigned to me, from the Thunder Bay side only, we were constantly in the dark as to the general nature of the geology of the country ahead of us. Whereas, by mapping that of the Nipigon district, we should have determined the geology of the two sides, and thus rendered it much easier to work out that of the intervening area. Having ascertained from the officers of the Hudson Bay Company and the Indians, that Lake Nipigon was much larger than commonly supposed, and considering how desirable it would be, for our purposes, to have a complete traverse of its shores, I engaged Mr. Peter McKellar of Fort William, who is both a surveyor and a geologist, to assist me in the undertaking; and the result proved that I was very fortunate in doing so.

Before starting from Fort William, I had the honor to receive the additional instructions, which had been forwarded to me by Sir W. E. Logan, at the suggestion of the Honorable Mr. McDougall, then Minister of Public Works. These directed me to take levels, and to make all possible observations with a view to ascertaining the practicability or otherwise of a railway to the North-west Territories through the country which we might examine. I am happy to have been able to report that our explorations have enabled me to trace a route which appears to be quite practicable for such a purpose, as far as we went, or through a distance of about one hundred miles in the proposed course, beginning at Lake Superior. In the following pages, I propose to add some details to those which were contained in the special report of 22nd February on this subject, which I had the honor of addressing to you. *

Plan of survey.

The Nipigon River having been carefully surveyed by Mr. Herrick, it only remained for us to make what geological observations we could, while ascending it. Having arrived at Lake Nipigon, I divided our party, and gave Mr. McKellar charge of one of the sections. Beginning on the south side of the lake, at the point where Mr. Herrick's line intersected the shore, Mr. McKellar proceeded to the right, or east side, while I took the west. At the end of about eight weeks, the two parties met at the northern extremity of the lake, having completed a survey of its shores, excepting the deepest parts of a few of the bays. We had also explored, and in some cases surveyed, the lower reaches of the principal rivers entering the lake, and determined the positions and forms of about 460 of the islands, lying within easy reach of the shore, and more roughly the positions and outlines of about 100, lying further off; while time did not permit of our ascertaining, personally, anything with regard to a considerable number in the centre of the lake. When on the south-west side, I made a journey of several days into the interior, following the lakes and streams, and making portages between them. In this excursion, I was guided by Chief Manitousaise's son, Tchiatang, a very intelligent Indian, whose services I had secured for the summer; and I had on this occasion, an opportunity of proving the accuracy of the sketch-maps of the region which he had previously made for me. This man had travelled a great deal in the Nipigon country, and beyond it. Having a very correct idea of distance, by using a compass, laid upon the paper, to guide him as

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* Transmitted to the Honorable Secretary of State for the Provinces, 28th Feb., 1870.

to direction, he prepared for me a number of sketch-plans, shewing the geography of the districts through which he had travelled, together with a great deal of other useful information. The country south of Gull Bay on Lake Nipigon, was explored by following the Kabitotiquia River and making a portage from it to Chief's Bay on the same lake.

Measurements

Our surveys on either side of Lake Nipigon, which were effected mostly by triangulation, were carried on in two bark canoes. Distances were checked and details filled in by the Rochon micrometer. The angles were determined by the sextant and Troughton's repeating circle, the local magnetic variation being so great and so uncertain as to render the compass of little use on most parts of the lake-shore. A true meridian was occasionally laid down, by which to fix the directions of our lines; and latitudes were taken for the purpose of checking our measurements. The heights of some hills were ascertained by angles of elevation, or by means of two aneroid barometers, which were also used in determining the amount of fall in the rapids of the Nipigon River.

Black Sturgeon lake and river.

In returning from Lake Nipigon, Mr. McKellar made an actual survey of the west shore of Black Sturgeon Lake, and of the river of the same name, as far down as Nonwatan Lake, and an approximate one from that lake to its mouth; whilst I, returning by the same stream, made two traverses of the country lying between it and the Nipigon River. On my return to Lake Superior, a partial examination of the north-west shore of Black Bay was effected; some additional explorations were made on the north side of Thunder Bay, and along the Red River Road, as far as it had been opened, after which the work of the season was brought to a close, and the party returned home, all well.

Throughout the season, I worked upon the principle which we have always pursued upon the Geological Survey, in exploring or surveying in a new region, namely, that of following, as much as possible, the water-courses, instead of cutting "exploratory lines" in the woods. The following may be mentioned amongst the many advantages of this system: (1) We avoid the expense of cutting the lines, which would add but little to our knowledge of the natural features of the country, and would soon be obliterated. (2) The clear space afforded by the surface of the water serves better than an artificial opening in the woods for measurements by the micrometer, which may be made as accurately as by the chain. It also admits of triangulation, which is impossible in the forest. (3) A greater distance may be surveyed per day. (4) A smaller party can do the work. (5) The canoes or boats by which the survey is carried on, also serve to convey, at the same time, the supplies of the party, and allow of a considerable quantity being taken, thus enabling the work to go on continuously for a greater distance, or a longer time, without reference to the base of operations, than where everything has to be carried on men's backs. (6 The river-beds and lake-shores afford many more exposures of the rocks than are to be met with in the woods, where they are covered by earth or moss. (7) The same measurements, which serve to determine correctly the distribution of the rock-formations, also enable us to lay down the topographical features of the country, and thus we obtain a knowledge of its geography simultaneously with that of its geology.

Summary of season's work.

The principal results of the season's operations may be briefly summed up as follows:

1. The working out of the geology of the country around Thunder Bay, including an area of the Huronian system not previously recognized, and the addition of many new facts in regard to the mineral veins of this region.

2. A survey of Lake Nipigon and portions of several of the rivers flowing into it, and the obtaining of approximate levels along the Nipigon River, besides an examination of much of the country near Lake Nipigon.

3. Ascertaining the fact that a large area north of Lake Superior, including the Nipigon country, is occupied principally by the Upper Copper-bearing and Huronian rocks, instead of the Laurentian, as had been supposed, and that it therefore offers a greater probability of the discovery of valuable minerals, and besides, affords a much better country for colonization and for the construction of highways.

4. The discovery of an apparently easy route for a railway to the North-West Territories through the country explored, for a distance of about one hundred miles from the mouth of the Nipigon River on Lake Superior.

For the sake of convenience, the tracts examined will be described in the following separate sections as: 1. The Thunder Bay region, embracing the country from Pigeon River to Black Bay. 2. The valley of the Black Sturgeon River. 3. The Nipigon River. 4. Lake Nipigon and the surrounding country. These will be followed by sections on the economic minerals of the district examined, surface-geology, soil, timber, climate, the opening of the Nipigon country for colonization, the railway route, and other matters.

Geological map

I have laid down our surveys of Lake Nipigon and the rivers entering it, and of Black Sturgeon Lake and River, together with Mr. Herrick's survey of the Nipigon River, and Admiral Bayfield's of a portion of Lake Superior, all in a connected form, on a scale of one inch to the mile, upon the large sheet accompanying this Report. It was satisfactory to find, on plotting the work, that the measurements of Mr. McKellar and myself, around the opposite sides of the lake, closed very well. The accompanying map of the whole country between Pigeon River and Nipigon Bay on Lake Superior, and northward to the waters flowing into the Albany River, on a scale of one inch to four miles, is based upon Mr. Robert Barlow's compilaiton of all the actual surveys which have, at any time, been made within that region, with the addition, by myself, of the other features, as nearly as they can be laid down, from all other sources available up to the present time. Upon this, I have represented the geology, as far as it has been determined by Sir W. E. Logan and Mr. Murray, and from the explorations of last year, with the addition of the information derived from Mr. McKellar and others already mentioned.

GEOLOGY.

The rocks of the country examined during the season belong to the Laurentian, Huronian and Upper Copper-bearing series. For the sake of facilitating my description of

THE UPPER COPPER-BEARING ROCKS,

Upper Copper-bearing rocks.

I will introduce the following list, which represents, in ascending order, the subdivisions of this series, as far as known, in the region under consideration. It is prepared from the descriptions by Sir W. E. Logan, in the *Geology of Canada*, and those by Mr. Thomas Macfarlane in the *Canadian Naturalist*, as well as from our own observations during the past season. As this district is, even yet, but imperfectly examined, some portions of the series may have been overlooked, and, therefore, this provisional arrangement of its members may require modification at some future time. The figures in brackets are only a rough approximation to the thickness in feet, and are given provisionally, merely to convey an idea of the proportionate volume of each division.

Lower Group.

Lower group.

1. Conglomerates composed of pebbles of quartz, jasper and greenish slate, in a greenish arenaceous matrix. Seen on the north shore of Thunder Bay. (70)
2. Chert layers, mostly thin and having a ribbon-like appearance in cross section. The mass is generally dark, but some light-colored layers occur. Thin beds of dolomite sometimes separate the chert layers from one another, and argillaceous layers are also occasionally interstratified; while bands of dolomite, which are themselves sometimes separated by argillaceous beds, are interstratified with the foregoing. The chert bands contain iron pyrites in specks, nodules and thin interrupted layers. A mineral resembling anthracite also occurs in the rocks of this and the following division. Seen at the eastern extremity of Thunder Bay, and near the five-mile post on the Red River road. (300).

3. Darkly colored massive argillites and flaggy black shales, the mass being characterized by numerous vertical joints, running in two directions, and dividing it into blocks of a very symmetrical character. The shaly portions hold regularly formed spheroidal concretions of various sizes. Trap beds are associated with these rocks along the north shore of Thunder Bay, at the Thunder Bay Mine and in the township of McIntyre. The shales are seen on the lower part of the Kaministiquia River, especially at the Grand Falls, and along the coast of Lake Superior, between Fort William and Pigeon River, while an example of the massive variety may be seen in the workings at the Thunder Bay Mine. (450)

4. Gray argillaceous sandstones and shales, mostly thinly and evenly bedded, fine grained and slightly calcareous. Examples of both of these rocks may be observed on each side of Thunder Cape, and in the township of McIntyre. In the southern part of this township, and at the north-western corner of Neebing, bands of sandstone, supposed to belong to this division, occur, containing a large percentage of magnetic iron ore. (400).

Upper Group.

Upper group.

5. Alternating red and white dolomitic sandstone, with a red conglomerate layer at the bottom, occurring on Wood's Location, Thunder Cape. Mr. Macfarlane finds the red sandstone to contain 12½ per cent. of carbonate of lime, and 11 per cent. of carbonate of magnesia. (40).

6. Light gray dolomitic sandstone, with occasional red layers, and spots and patches of the same color. These sandstones occur along the south-west side of Thunder Bay, and on Wood's Location, where Mr. Macfarlane found them to contain 13 per cent. of carbonate of lime and 12 per cent. of carbonate of magnesia. (200).

7. Red sandstones and shales, interstratified with white or light gray sandstone beds, frequently exhibiting ripple-marked surfaces, and also with conglomerate layers, composed of pebbles and boulders of coarse red jasper in a matrix of white, red or greenish sand. (500).

8. Compact light reddish limestones (some of them fit for burning into quick-lime,) interstratified with shales and sandstones of the same color. (80).

9. Indurated red and yellowish-gray marl, usually containing a large proportion of the carbonates of lime and magnesia, the amount varying in specimens analysed by Mr. Macfarlane, from 21 to 34½ per cent. of the former and from 7½ to 13½ of the latter. This division runs through the centre of the peninsula between Thunder Bay and Black Bay, and may, in this region, have a thickness of 350 feet or more. (350).

Upper Copper-bearing series.

10. Red and white sandstones with conglomerate layers, the red sandstones being often very argillaceous, and variegated with green spots and streaks, and having many of their surfaces ripple-marked. These rocks are found all along the north-west side of Black Bay as far up as the township of McTavish. (200).

11. On the opposite side of Black Bay, conglomerates and sandstones, mostly of light color, are interstratified with layers of trap, often amygdaloidal, and succeeded by beds of trap, largely developed in the peninsula between Black Bay and Lake Superior, and perhaps belonging in part to the next division. (6,000 to 10,000).

12. The great crowning overflow of columnar trap, which caps the hills from the Pigeon River to the Kaministiquia, and forms the summit of Thunder Cape. It is characterized by numerous joints, dividing it into large columns at right angles to the plane of the mass. The rock is hard, more or less coarsely crystalline, and composed principally of varieties of augite and feldspar, with magnetic iron.

Unconformable trap.

While different portions of this series were found overlying unconformably, in some places the Laurentian, and in others the Huronian series, the additional facts, which have been observed during the past summer, leave little doubt that the great trap overflow, part of which has been mentioned as crowning Thunder Cape, rests in different places, sometimes unconformably, upon different members of both the upper and lower groups of the Upper Copper-bearing series. Sir W. E. Logan has already pointed out a want of conformity between it and the limestones and sandstones (9 and 10), and noticed the more horizontal attitude of the overlying trap. (*Geology of Canada*, pages 70 and 79.) On the south side of the lower reach of the Kaministiquia, and in the country south-eastward from that river, to the shore of Lake Superior, the trap is found resting upon the almost horizontal shaly, cherty and jaspery beds, belonging to the lower part of the series. In 1868, Mr. McKellar observed the gray argillaceous sandstones (4) running under the trap on the north side of Thunder Cape; and last season, Mr. Macfarlane detected the higher conformable dolomitic sandstones and conglomerate layer (5) also underlying the trap, and in unconformable contact with it, on Wood's Location on the south side of the cape. On the west side of Nipigon Harbor, the same columnar trap is seen resting upon indurated red marl, believed to belong to the ninth division of the foregoing list. In the valley of the Black Sturgeon River, the same trap appears to overlie conformably the almost horizontal sandstones, red shales and marls; while in the neighborhood of the portage from Black Sturgeon Lake to Lake Nipigon, a similar rock is associated with beds of light gray sandstone and dark compact argillite in a vertical attitude; a great mass of trap of the same character, occurring on a higher level, appears as if it might overlie the whole unconformably. Additional details in regard to these rocks, as they occur on Lake Superior and around Lake Nipigon, will be given further on, but much remains to be done before their sequence is properly worked out.

Age of Upper rocks.

The age of the Upper Copper-bearing rocks has always been considered as doubtful, and although provisionally classified with the Lower Silurian, the name which they received was intended merely to distinguish them from the Huronian, or Lower Copper-bearing series. It has been mentioned by Sir W. E. Logan in the *Geology of Canada*, page 85, that the difficulty in determining their age arises from the absence of fossils of any kind. As, however, new facts accumulate in regard to them, it becomes probable that they may now be considered as of Permian and Triassic age. Being of a different general lithological character, as shewn in the foregoing list, and much greater thickness than the Lower Silurian rocks of any contiguous part of the continent, and being without fossils, which are generally so abundant in these rocks, are all facts unfavorable to the supposition of their being of Silurian age ; while the prevalence of such great volumes of marls and sandstones charged with the red oxide of iron, and of great overflows of basalts, amygdaloidal and other trap rocks, the peculiar composition of the dolomitic sandstones, together with the presence of various zeolites and native copper, and the existence of brine springs, cause them to bear a strong resemblance to the rocks of Permian or Triassic age in Nova Scotia.

THE THUNDER BAY REGION FROM PIGEON RIVER TO BLACK BAY.

The shore of Lake Superior, from the boundary line at Pigeon River to the mouth of the Kaminitiquia, is overlooked by bold cliffs, coming close to the lake, and rising to a height of from 500 to 1000 feet above its level. This part of the coast, as pointed out in the *Geology of Canada*, p. 77, is occupied by the shales of the lower group, while the higher hills are all capped by the great basaltic trap overflow, which, as already mentioned, appears to constitute the newest member of the whole series. The same rocks seem to occupy the entire area northward to the Whitefish Lake and River, where they terminate in bluffs facing the north-west, similar to those which face to the south-east on the shore of Lake Superior. A corresponding arrangement marks the northern boundary of this area, where, to the south of the Kaminitiquia, below the mouth of the Whitefish River, and nearly corresponding with the southern boundary of the townships of Neebing and Paipoonge, high north-facing bluffs of trap, resting upon the lower members of the series, overlook the valley of the river. The shales and associated rocks, which crop out at a low angle from beneath the trap, continue, however to the north side of the lower stretch of the river.

Rocks of the shore.

Their northern boundary would be roughly indicated by a line drawn from the Grand Falls, to a point on the shore of Thunder Bay, about six miles east of the mouth of the Current River.

As pointed out in the *Geology of Canada*, p. 67, the lower members of the formation, which underlie the trap in this region, consist, in ascending order, principally of conglomerates, chert beds, hard shales of a bluish-black color, with some dolomite layers, and sandstones. Interstratified beds of more or less crystalline dark colored trap also occur in several parts, particularly towards the bottom of the series, and dykes of the same rock are common. The whole formation has a general dip, at a very low angle, to the south-eastward, or towards the lake. The darkly colored cherty and jaspery beds are often finely mottled with darker and lighter shades of green and spots of black and red. Sir W. E. Logan has referred to the occurrence of pebbles of this character on the shores of Thunder Bay. The rock was found in place on the flanks of Rabbit Mountain in the township of Paipoonge, three miles south of the Kaminitiquia River. Bands of reddish jasper were found in the slates on the opposite side of the river, at about the same distance from it. The occurrence of upwards of one hundred feet of the dark hard argillaceous shales, lying nearly horizontally at the Grand Falls of the Kaminitiquia River, is noticed in the *Geology of Canada*, page 68. Similar rock was found *in situ*, in several places on the river below the falls, the lowest being on lot 13, range A., about six miles from its mouth. It was also traced for two or three miles up the bed of the Slate River, which enters the Kaminitiquia, on the south side, near the east town-line of Paipoonge.

Jasper rocks.

A trap dyke, curiously weathered, and standing up conspicuously out of the shale, crosses the stream about half a mile above its mouth. The bed of the Whitefish River is much encumbered with boulders, but the shales are seen here and there in the lower part of its course. At about twelve miles south-west of Fort William, and two or three miles north-west of the shore of Lake Superior, opposite Pie Island, a lake occurs, called Ka-zee-zee-kitchi-wa-ga-mog, which was surveyed by Mr. W. W. Russell, of our party. It was found to be seven and a-half miles long, in a north-east and south-west course, and one mile wide in the middle, and surrounded with high bluffs of trap, like that crowning McKay's Mountain. Its surface has an elevation of several hundred feet above Lake Superior, and Sucker Brook, which discharges its waters into the lake, rushes down over the underlying almost horizontal shales. These contain numbers of singular spheroidal concretions, similar to these observed by Sir W. E. Logan in the shales of the same formation, in the bed of the Kaminitiquia.

A river entering Lake Superior, between Pine River and Sucker

Cloud River.

Brook, called by Mr. McKellar Cloud River, was followed by him to Cloud Lake, a distance of about six miles from its mouth. He found the shales and associated rocks of the lower group all along the bed of the stream, while the tops of the hills were composed of the trap of the crowning overflow. The whole of the district between this part of the north-west shore of Lake Superior, and the Whitefish Lake and River, is described as very broken, with numerous lakes surrounded by bluffs of trap. Whitefish River, which was found to be unfit for canoeing, except for a mile or two from its mouth, does not flow from the lake of the same name. Its upward course is described as curving round to the northward at about twelve miles from its mouth. Whitefish Lake is about seven miles long from east to west, and about two miles wide. High trap bluffs are said to overlook it on the south side. Proceeding westward, shales, similar to those of the lower part of the Kaminitiquia, are reported as occurring between Arrow and Gun-flint Lakes, and a specimen of the dark variegated jasper of this series, picked up on the shore of the latter lake, where it was said to exist *in situ*, was given me by a gentleman who had just come through it in a canoe. The south shore of the lake is said to be steep, and it is probable that the great trap overflow extends thus far. The Upper Copper-bearing rocks would appear to terminate at the west end of Gun-flint Lake.

The stratified rocks, both of the mainland and the islands from Pigeon River to the Kaminitiquia, and from Thunder Bay for a considerable distance eastward, are cut by innumerable trap dykes of all sizes, running parallel to each other, in a northeasterly course. They, therefore, form a slight angle with the general direction of the shore, it having a more northerly trend.

Selkirk's road.

The Hudson Bay Company's winter trail from Fort William to Basswood Lake, follows the Whitefish River, Lake, and Portage, in going from the Kaminitiquia to Arrow Lake, but this route is impracticable for canoes. Many years ago, Lord Selkirk had a waggon-road opened from the Paresseux Rapids on the Kaminitiquia, to Whitefish Lake, which was used as a summer route, in connection with the boundary-line chain of lakes. The valley of the Kaminitiquia, from the mouth of the river to the junction of the Whitefish, a distance of about twenty miles, is covered with yellowish sand and loam, underlaid, in the lower levels, by bluish-grey clay. The breadth of these alluvial deposits from north to south, on the dividing line between Neebing and Paipoonge, is about seven miles, and it is apparently greater here, than either above or below. The soil does not appear to be fertile, except close to the river, and towards the mountains on the south side, where hard maple occurs in groves, which are used by the Indians for sugar-making.

North of this alluvial tract, at the south-west corner of mining-lot 1, Herrick's survey, three-fourths of a mile north of the town-line of Neebing, nearly horizontal calcareous beds occur, containing small coral-like silicious concretions and vertical cylinders of chalcedony, transverse sections of which shew fine concentric rings resembling agate. Beds of dolomite are seen about the north end of lot 3, of the same survey. Sandstone, containing magnetic iron, is found on lots 1, 2 and 3, Herrick's survey. On the northern part of mining-lot 54, adjoining the last, black silicious shales occur, which, with the other strata in the neighborhood, have a slight dip to the eastward. An exposure of trap, supposed to be a dyke, appears in a swamp on mining-lot 55, between lot 3 and the north line of Neebing. At a place called the Algoma Mine, on the north-west corner lot (25 in the 5th range north) of Neebing, there is an outcrop of thinly-

Iron ore.

bedded, flaggy, hard, dark grey sandstone, largely composed of particles of magnetic iron, and weathering to a rusty color. A brook, with a perpendicular fall of fifteen feet, has here cut a channel through the rocks, and exposed about twenty feet of the beds, which lie almost horizontally, or dip very slightly to the north. A specimen, which appeared to represent the greater part of the mass, has been found by Mr. Broome, the chemical assistant to the Geological Survey, to contain 37.73 per cent. of metallic iron, so that the rock may be considered an iron ore. Three veins, one of them thirty-one feet in width, and holding galena, occur here. These, with the iron-sandstone, will be more fully described under the head of Economic Minerals. The same highly ferruginous sandstone, dipping very slightly east-north-east, is again exposed on the banks of a brook on mining-lot B, rather more than a mile north-east of the Algoma Mine.

Copper ore.

On mining-lot C, about two miles north-east of the Algoma Mine, a vein, which contains copper pyrites, and will be again referred to, cuts the same sandstone, which here has a horizontal attitude. At a mile from this locality, in a course bearing N. 35° E., and about the south end of mining-lot G, there is a north-east facing bluff, thirty feet high, composed of similar sandstone, having a slight dip to the south-westward. Following the same course, at half a mile from this locality, there occurs, on mining-lot H, an exposure, fifty feet wide of dark compact, fine-grained trap, running S. 75° W., (mag.), but whether belonging to a dyke or a bed could not be determined ; and at about one mile, on mining-lot J, a south-facing cliff, of similar trap, about twenty feet high. Further on, another south-facing cliff of trap occurs, at three hundred and fifty yards from the last ; and at half a mile, a high north-facing bluff of the same rock is met with on the north ends of lots J and K, running N. 75° E. (mag). About a mile to the east, on mining-lot L, this bluff sweeps around, and forms the termination of a ridge pointing to the east-north-east, which is seen conspicuously from Thunder Bay. The upper fifty feet or more, at the termination of this ridge, consist of trap, but the black shales appear to run below it, in which case, it would belong to a bed interstratified with the sedimentary strata of the group under consideration.

Trappean rocks.

On the east side of the Current River, three ridges, composed of similarly interstratified trap, each having a north-easterly course, are met with on the Thunder Bay Mining Company's location, and the lots adjoining it on the east, and a fourth runs in the same direction across the southern part of the Shuniah Mining Company's location. From Bare Point on the former location, a ridge of trap runs almost due west a considerable distance, and may also be an interstratified mass. The surface of the trap, on the south side of the point, dips south, at an angle of 20° to 25°, and the black shales are found on each side, close to it. The trap which is met with at the commencement of the Red River Road occurs in a similar manner. Along the north shore, from Bare Point, eastward to the head of Thunder Bay, a distance of twenty miles, nearly all the islands, including Kitchi-minis, or Big Island, and the extremities of almost all the points, are composed of trap, associated with the shales, and in most cases, resting upon the lower portion of the group. The Welcome Islands, opposite the mouth of the Kaministiquia, and four miles from it, are composed of the grey argillaceous sandstones of the lower group, and trap, apparently belonging to dykes.

Boundary of Laurentian and Huronian.

On the Kaministiquia River, as indicated in the *Geology of Canada* page 68, the shales of this group come in contact with the older rocks, about one-third of a mile above the Grand Falls. In tracing eastward the line which marks the southern boundary of the Laurentian and Huronian rocks, it is found, after a few miles, to make a bay to the north, crossing the Red River Road, about ten miles from Thunder Bay, returning to it at four and a quarter, and recrossing again at three and a quarter miles. The interval is occupied by the thinly bedded black chert, hard dark shales, weathering black, and some arenaceous and conglomerate beds, which lie almost horizontally where they come up against the gneiss. On the bank of McIntyre's River, on mining-lot M, there is an exposure of arenaceous beds and dark slates, like those at the Grand Falls of the Kaministiquia, all weathering to an iron-black. Some of the beds here are composed of small black hard rounded grains, in a white apparently silicious cement. The strata dip north 40° west (mag.) $< 15^\circ$, and have a thickness, in the exposed section, of one hundred feet or more. A brecciated vein, forty feet wide, which will be again mentioned, crosses the river on this lot. From the point where it intersects the road, at three and a quarter miles from Thunder Bay, the boundary of the gneiss runs north-eastward to the Current River, which it crosses on mining-lot S. At this place, the Laurentian rocks appear to be confined to a narrow breadth on the river, and to be flanked by the black shales on the south, and by the dioritic slates of the Huronian formation on the north.

Limit of Copper-bearing rocks.

From the intersection of Current River, the southern boundary of the older formations runs about due east, coming to the shore of Thunder Bay near Goose Point, seven miles from the mouth of the river. Continuing eastward, it cuts off all the points, (the metamorphic rocks being seen at the bottoms of the coves), along the north coast of Thunder Bay, to within four miles of its head, where it strikes inland, with a north-easterly bearing. Between the Current River and the head of the bay, the Upper Copper-bearing rocks repose, in some places, upon the Laurentian, and in others upon the Huronian series. At the Thunder Bay Mine, one of the thick beds of trap, already referred to, is underlaid by about fifteen or twenty feet of alternating beds of dark shale, impure dolomite, argillite, and what appear to be diorite layers. These are followed, in descending order, by massive dark olive and drab-grey argillaceous slate, about fifty-five feet of which have been cut in the shafts, the whole lying almost horizontally. An exposure of dolomite occurs about a quarter of a mile north-east of the mine, which is two and a half miles north-east of the mouth of Current River, and one mile north-west of the shore of Thunder Bay.

LAURENTIAN AND HURONIAN SYSTEMS.

Laurentian.

Northward from the limit of the Upper Copper-bearing rocks, which has just been defined, between the Grand Falls of the Kaminitiquia and the head of Thunder Bay, the country is occupied partly by Laurentian and partly by Huronian rocks, to a distance of about eight miles from the former; and about sixteen from the latter. The distribution of the two formations is represented, as accurately as possible from present data, upon the accompanying plan. North of this area is the country around Dog Lake, which is all Laurentian, so far as known. The gneiss of the Dog Lake region is remarkable for being distinctly stratified, and containing much mica, while that of the outliers to the south is very massive, and generally rather of the character of syenite and granite. The Huronian rocks of this region consist of slates, some of them dark green and composed of hornblende, some greyish-green and dioritic; others are light-colored, fine-grained, quartzose, somewhat nacreous micaceous schists; while dioritic slate-conglomerates, quartzites, fine-grained felsites, massive diorites, ribboned jasper and iron ore, also occur.

Dog Lake.

Dog Lake is of an irregular V-shape, the apex, at which the outlet occurs, being pointed to the south-west. From the outlet, one arm stretches north-eastward fifteen miles, while the other extends east eighteen miles. The breadth of the body of the lake, between the junction of the two arms

Laurentian gneiss.

and the outlet, is from two to four miles. From the eastern extremity of the lake, the general strike of the gneiss is westward, with the course of the longer arm, gradually curving round, till at the outlet it becomes south-west. Following down the Kaminitiquia River, from the outlet of Dog Lake to near the junction of the Mattawa River, where the gneiss terminates, the strike continues to curve a round from south-west to south, and finally to south-south-east. On the south shore of Dog Lake, about one mile east of the Little Dog Portage, the gneiss, which is coarse-grained, and reddish, is full of irregular branching veins, (some of them a foot thick) of flesh-colored feldspar in large crystals. They run mostly with the stratification, which is here on edge, and striking S. 75° to 80° W. (mag.). In the neighborhood of the outlet, and along the Kaminitiquia River, to Little Dog Lake, the rock is principally mica schist.

Three miles below the head of Little Dog Lake, the gneiss dips N. W. at an angle of 70°. At the first portage, which is about three and a quarter miles below the same point, gneiss of a greyish and reddish color occurs, associated with mica-schist holding garnets. The strata, which are on edge, strike S., from 5° to 10° E., and are overlaid, unconformably, by a mass of rather fine-grained, dark reddish-grey syenitic granite, containing greenish and yellowish crystals of triclinic felspar. At from three and a half to four miles below the first portage, reddish gneiss occurs, dipping eastward at an angle of 65° to 75°. The junction of the Laurentian rocks and the greenish Huronian slates, occurs on the Kaminitiquia River, about a quarter of a mile above the mouth of the Mattawa. Eight miles east of the Kaminitiquia, the line between the two formations crosses the Old Dog Lake Trail, at fifteen miles from Thunder Bay. Northward from this point, the trail, for two and one half miles, passes over massive red syenite, studded with large crystals of flesh-colored orthoclase feldspar, which give it the appearance of a very coarse porphyry. It shews no trace of stratification or lamination of any kind, and the feldspar crystals, which measure from one to two inches on the side, have no regularity of arrangement. At about eighteen miles from Thunder Bay, the trail crosses a ridge of rather fine-grained reddish-gray granite, composed of about equal parts of quartz, feldspar and mica. Between the twenty-mile station and the southern bay of Dog Lake, which is about twenty-four miles from Thunder Bay, fine-grained micaceous gneiss and mica-schist, running south, 15° west, (mag.) with a vertical dip, are seen in places on the trail.

As already remarked, between the third and fifth miles the Red River Road passes over a spur of the Laurentian area, which lies between it and the Current River. Where it first makes its appearance on the road, at about three and a quarter miles from Thunder Bay, Laurentian rocks.

it consist of very light reddish-gray quartz rock, with a little feldspar, and small specks of black mica. About a mile further on, very dark green silicious slate and hornstone are met with, running N. 70° E. (mag.) and vertical. They are associated with a dark green coarse-grained massive rock, resembling diorite, and may belong to the Huronian series. About a quarter of a mile north of the five-mile post there is a prominent point of coarse-grained gray syenitic gneiss, containing large flesh colored crystals of feldspar. Thin bands of a black micaceous hornblende rock, and small compact reddish bands, run irregularly east and west in the mass. Dykes of black trap, which have a zig-zag appearance, owing to numerous small dislocations, cut it in a north and south course. One of these dykes was observed to enclose patches of the country rock.

The Dog Lake Trail leaves the Red River Road about the seventh mile, and soon comes upon the gneiss, which is exposed along it for a breadth of five miles, when the Huronian slates commence. It consists of reddish and grayish gneiss, alternating in thick and thin bands, and striking generally at right angles to the road, or about east-north-east and west-south-west; but at about a mile from its northern limit it appears to dip west at an angle of 60°.

At the ten-mile post, on the Red River Road, there is an outcrop of massive light reddish-gray syenite, containing more feldspar than quartz, and conspicuously marked with elongated crystals of black hornblende.

The band of gneiss, already mentioned as occurring on the Current River on mining-lot S, as well as another which crosses the same river about eight miles from its mouth, are believed to be spurs from this area.

Syenite.

Coarse grayish-red syenite occurs between two branches of the Current River, ten miles from its mouth, also on the shore of Thunder Bay, near Goose Point, and three miles north of it, and again near the shore, for three miles on each side of McKenzie's River. In each of these places it appears to form an outlier, surrounded by the Huronian slates. A similar rock was found by Mr. McKellar on the Current River, at nineteen miles, in a straight line, from its mouth, and the main body of the Laurentian gneiss is about one mile farther on. To the east of Current River, and at a distance of four or five miles north of Thunder Bay, there occurs a range of hills of gneiss and syenite, which continues eastward to Black Bay. A spur from this range comes out upon the west shore of Black Bay, at Granite Point, and a number of small outliers, surrounded by the red marls of the Upper Copper-bearing series, occur to the south of the range, in the township of McTavish. Granite Island, in Black Bay, is also Laurentian. The rock at all the last mentioned localities is pink, of a granitoid character, composed mainly of feldspar and quartz, not coarsely grained, and containing no mica and very little hornblende.

In ascending the Kaminitiquia, the Laurentian rocks are first seen at about one-third of a mile above the Grand Falls, where gray quartzose gneiss, containing some feldspar, is exposed at the second portage, and is overlaid by hornblendic, passing into dioritic schist, containing actinolite crystals and specks of iron pyrites, and dipping N. 5° W. (mag.)<60°. A breadth of 150 paces of this rock is exposed at the head of the portage. At about four miles above the Falls, grey micaceous gneiss occurs at the next or third portage. It contains colorless quartz, with white and yellowish crystals of feldspar, and a little hornblende. The rock is of a massive character, and encloses short lenticular patches of mica-schist, running with the stratification, which dips N. 5° W. (mag.)<75°

Between the margin of the Upper Copper-bearing rocks, on the north shore of Thunder Bay and the Laurentian range, already described, all the country not occupied by the syenitic areas which have been mentioned, appears to be composed of rocks of the Huronian series. These consist of diorites, dioritic conglomerates, hornblendic and fine-grained micaceous slates, with some quartzites. In ascending the Current River, the first four miles are upon the Upper Copper-bearing rocks, but beyond this, to a distance of about twenty miles in a straight line from its mouth, Mr. McKellar found nothing but Huronian slates of different kinds, with the exception of the gneiss band, at about eight miles, which has been already referred to. At the end of this distance he came upon the south-east border of the Laurentian area surrounding Dog Lake.

Huronian rocks.

On the old trail from Thunder Bay to Dog Lake, the space between the twelfth and fifteenth mile-posts is occupied by Huronian slates. Those on the south side of the interval have a green chloritic appearance, hold grains and cubes of iron pyrites throughout, and irregular patches of red and reddish-gray feldspar in the planes of bedding or cleavage, which is almost vertical, and runs N. 80° W. From thirteen and one-half to fourteen miles, the rock is a very dark hard greenish clay-slate, apparently on edge, and running generally N. 60° E. At fourteen miles, a band of a somewhat arenaceous character occurs, striking N. 65° E. It has been already mentioned, that in descending the Kaminitiquia River, the gneiss ends, and the Huronian slates begin, at about one-fourth of a mile above the junction of the Mattawa. Opposite the mouth of this river, the rock forming the bank of the Kaminitiquia is a fine-grained rather soft dioritic slate of greenish and bluish-gray colours. The general strike of the cleavage or bedding is east and west, varying ten degrees each way, and its dip southward, at an angle of about seventy degrees. It is cut by numerous short irregular veins or patches and strings of white quartz, holding a little lilac-coloured petalite. The course of these is about N. 25° E. (mag.) On the tops of the hills, near the south side of the Mattawa, and about one mile from its mouth, dark green silicious clay-slate occurs on edge, and runs N. 85° W. Massive and laminated bands, and bands of different shades of colour alternate. It contains numerous quartzose strings, weathering yellow, also reticulating strings and irregular parallel veins and strings of pure quartz. Spots or kernels of a lighter colour and more granular character than the rest of the rock run in irregular groups through it. The Huronian slates are said to continue westward, the whole length of the Mattawa River, and along the shores of Shebandowan Lake, from which it flows Mr. G. F. Austin, P.L.S., informed me that after going a few miles up the river he found the slates to assume a softer and more talcoid character than they possess at its mouth. A specimen of light-coloured, very fine-grained quartzose, somewhat nacreous, micaceous schist was brought by Mr. Andrew Bell, P.L.S., and one of dark greenish-grey clay-slate, by Mr. Thomas Monro, C.E., of the Public Works Department, from Shebandowan Lake; and the Indians have brought to me specimens of greenish hornblendic and dioritic slates from the same lake. In the hills on the left side of the Kaminitiquia River, a finely banded rock, made up of jasper and magnetic iron, occurs at the distance of one mile south-east of the junction of the Mattawa. The alternating beds are usually not more than from one-half inch to two inches thick, and present a very striking contrast; the jasper being brown or bright red, while the magnetic iron is black, finely granular and glistening. The beds are somewhat contorted, but their general strike appears to be about east and west. On the west side of the Kaminitiquia River, at about a mile and a-half below the Mattawa, the same ribboned jasper and iron-ore rock occurs, associated with black arenaceous layers, semi-translucent banded chert, approaching chalcedony, and dark fine-grained hard ribboned argillite or felsite, having a conchoidal fracture. These strata are considerably contorted, and dip at high angles, but their general course appears to be north-westward. On higher ground, overlooking the river at this locality, and possibly unconformable to the strata just described, are thick beds of fine-grained greenish-gray diorite, mottled with small light red patches, with others of a greenish-grey diorite, coarsely porphyritic from the presence of numerous crystals of greenish feldspar. The beds vary from one foot in thickness, up to fifteen or twenty feet, and strike N. 65° W. (mag.), with an inclination to the north-eastward of about 75°. Following the river downward, the dark green hornblendic, and lighter fine-grained mica-slates are observable wherever the rock is exposed, as far as the band of gneiss, which has been already mentioned as occuring at about four miles above the Grand Falls. The dip is northward, at angles varying from 50° to 70°. At a short portage, about a mile above the place where the gneiss occurs, there is a

Huronian rocks.

Jasper and iron ore.

Huronian rocks.

band of slate of a rather lighter colour than usual, and weathering yellow, from the presence of numerous grains of iron pyrites. It also holds grains of clear quartz, about half the size of peas, and in the cleavage planes, scales of silvery mica. In the *Geology of Canada*, (page 65) it is mentioned that in this part of the river some very large boulders with a brownish or blackish matrix, having much of the trappean aspect belonging to some of the varieties of the slate-conglomerate, and holding blood-red jasper pebbles and balls of iron pyrites, have been observed, resting upon the green slates, and apparently not very far removed from the parent rock.

Strawberry Brook joins the Kaminitiquia on the east side, about half-a-mile below the Mattawa. The lower reaches of these two streams, entering from opposite sides, lie almost in the same line, and appear to run on the same belt of rock. Following the Red River Road from the Kaminitiquia towards Thunder Bay, the green Huronian slates are the only rocks seen to within ten and one-half miles of the latter, where the red syenite, already mentioned, is met with. At thirteen and one-half miles, the green slate holds numerous specks of iron pyrites, and is cut by a north and south trap dyke, about five feet wide. In the neighbourhood of the eleven-mile post, similar slates, holding strings of quartz, are thickly spotted with white grains. The strike is here about north and south, apparently conforming with the western side of the gneiss area already referred to, between this road and Current River.

THE PENINSULA BETWEEN THUNDER BAY AND BLACK BAY,

is occupied entirely by the rocks of the Upper Copper-bearing series. The northern limit of the formation would be approximately marked by drawing a line from a point six miles north of the extremity of Thunder Bay, eastward to Granite Point on Black Bay. The lower group, comprising the chert bands, shales and argillaceous sandstones, is found near the water's edge, all along the south-east shore of Thunder Bay, from its head to Thunder Cape. From the head of the bay, these rocks extend inland to Silver Lake, a small sheet of water at a distance of four miles, in a northerly course, from the shore. In approaching the Cape, and when within about six miles of its extremity, the line marking the summit of the lower group sweeps round and comes to its south side, near Ryanton, which is situated about the middle of Wood's Location. On Thunder Cape, a cliff, three miles long, rises to a height of 1,350 feet above the water, and forms the most conspicuous headland on Lake Superior. The upper part of the cliff is composed of the columnar trap of the crowning overflow (12.) It is of a dark color and crystalline. Mr. Macfarlane has observed that the coarsely grained varieties prevail towards the summit, and those of a finer texture near the contact with the underlying strata; and a similar fact was noticed by myself in the Nipigon country. Trappean rocks. This trap is composed of grayish and greenish feldspar and hypersthene, with a little hornblende and magnetic iron. According to Mr. Macfarlane, the rock would be called hyperite. (*Canadian Naturalist*, new series, vol. IV, page 460.) The argillaceous sandstone beds, which underlie the greater part of the trap in the cliff, are almost horizontal, but still their surface appears to have been denuded or disturbed before the trap was laid upon it; and on the western part of Wood's location, where the eastern termination of the cliff occurs, Mr. Macfarlane found a distinct want of conformity between the great trap overflow and the underlying conglomerates and dolomitic sandstones (5), which rest conformably upon the argillaceous sandstones. The light gray dolomitic sandstones (6) sweep round from the shore of Lake Superior, on the eastern part of Wood's Location, to a point on the south-west side of Thunder Bay, about six miles from Thunder Cape, from which they continue north-eastward, forming a conspicuous cliff close to the shore of the bay, all the way to its extremity, and beyond it to Silver Lake. North of this lake, they are again found on the south side of the Laurentian range. The red sandstones and shales, interstratified with whitish sandstones and conglomerate layers (7), and the indurated red and yellowish-gray calcareous marls (9) run longitudinally, with a breadth of from two to four miles, through the whole length of the peninsula; and in the township of McTavish, they appear to spread out all along the south flank of the Laurentian range from Silver Lake to Granite Point, a distance of about eleven miles. In this interval, numerous spurs and outliers of the syenite protrude through the red marls. The compact light reddish limestones (8), which come between the two last mentioned sets of rocks, and which may prove valuable for burning into quick-lime, occur on the shore of Lake Superior in the vicinity of the eastern side of Wood's Location. The white and the red argillaceous sandstones with conglomerate layers (10) occupy the western side of Black Bay, from its entrance to McEachran's Point in the township of McTavish, and may extend inland, in some places, to a distance of two miles. Several lakes occurring on this peninsula, which have not hitherto been represented on the maps, are shown on the accompanying plan. We are indebted principally to Mr. P. McKellar for these new geographical features. The lake entering Wood's Location, but lying principally to the north of it, is estimated by Mr. Hugh Wilson, P.L.S., to be six miles long and three miles wide. The small lake on Thunder Cape has an elevation of several hundred feet above Lake Superior.

BLACK STURGEON RIVER.

Geographical details.

The country around the head of Black Bay, and across to Nipigon Bay, is low and level. The general upward course of the Black Sturgeon River, which enters the northern extremity of the former bay, sweeps round in a regular curve from north to north-west, and at the end of forty-four miles reaches Black Sturgeon Lake. This lake may be described as lying to one side of the general course of the river, the upper section entering the southern extremity of the lake only one mile and three-quarters west of the point where the lower section discharges from it. The upper section of the river, in ascending from the lake, is found to have, at first, a very tortuous course, with low land on each side. At three or four miles south-west of the point at which it enters Black Sturgeon Lake, it divides into two branches, in following either of which, we pass through a lake; Pike Lake on the more southerly branch being about two miles across, and Cyclas Lake on the other, about one mile. At about fifteen miles from Black Sturgeon Lake, the southern branch enters a hilly country, and the northern branch at about thirteen miles; but east of this range, the whole tract through which the two branches pass is comparatively level, and the country continues so to Black Sturgeon Lake and the lower section of the river. The upward course of the south fork of the river just mentioned, extends south-westward in two principal branches (each proceeding from lakes) to a distance of about thirty miles beyond the point at which it enters the hilly country; so that the whole length of the general course of the river would be about ninety miles, but following its windings, about double that distance. Black Sturgeon Lake stretches in a north-westerly direction. It measures two miles in width by thirteen in length, and comes within about one mile of the southern arm of Black Sturgeon Bay on Lake Nipigon. A valley, paved with rounded boulders, extends from one to the other. The two lakes appear to have nearly the same level. I was informed by an old Indian that, in former times, whenever the water happened to be high, a small quantity flowed from Lake Nipigon into Black Sturgeon Lake, but that it had altogether ceased to do so for the last thirty-five years. The water of Black Sturgeon Lake and River is very dark, while that of Lake Nipigon is remarkably clear. A small brook enters the south arm of Black Sturgeon Bay, and its dark-colored water fills the arm northward to the open bay, where it mingles with the clear waters of Lake Nipigon, which could not happen if the water flowed from this arm into Black Sturgeon Lake. A pond, one quarter of a mile long, occurs on the portage, and it is just possible that a little water may find its way, under the boulders, from Lake Nipigon to Black Sturgeon Lake; but, if so, the quantity must be very small, as the Black Sturgeon River appears to be as large where it enters as where it leaves the lake, although several large brooks fall into the latter on either side, and appear to be quite sufficient to compensate for the evaporation. A well marked water-line, three feet over the summer level of 1869, was observed on the rocks in many places around the shores of Lake Nipigon. The Indians say that previous to thirty-five years ago, the water had stood for a long time at this height, and that it then gradually fell for several years, until it reached its present level. Leaving Black Sturgeon Lake, the river of the same name runs nearly straight, in a south-easterly course, and is very rapid for six miles and a-half, when it enters Nonwatan Lake. This picturesque sheet of water is three and a-half miles long, from north to south, and one mile and a-half wide in the middle. It receives a considerable stream called Nonwatan River, from the westward, the upward course of which lies south-westward for a considerable distance, through a level country. Leaving this lake, the Black Sturgeon River flows sluggishly between marshy borders for the distance of a mile, to Lake Nonwatanose (or Little Nonwatan), one mile in diameter and nearly round. At two miles and three-quarters below this lake, we come to Esh-quanonwatan Lake, two miles in length, and the last one on the river.

Black Sturgeon River.

It has been mentioned that a level tract of land occurs on the west side of Black Sturgeon Lake, and along the upper section of the Black Sturgeon River. This continues down the western side of the lower section to a distance of about three miles below the last lake, from which point the river, for a distance of fifteen miles, is approached, at intervals, on either side by high hills, leaving a valley of perhaps three or four miles in width between them. Below this, the country again becomes level to Black Bay on Lake Superior.

From the last lake, the river is extremely crooked all the way to its mouth. It is interrupted by numerous short rapids, mostly over boulders, between which the current is slack, with deep water and a muddy bottom. The banks are composed of fine sandy clay, and vary from four to forty feet in height. Descending from Black Sturgeon Lake, our larger canoes, manned by white men, ran all the rapids in the river, excepting one, in which there is a slight perpendicular pitch. The river is observed to increase rapidly in volume all the way from Black Sturgeon Lake to its mouth, where it has become one of the largest rivers entering Lake Superior. The principal tributaries join it from the west side, the country between this river and the Nipigon not being of sufficient breadth to afford large streams, and such as do exist between the two rivers fall mostly into the latter. The largest of these western branches falls into the Black Sturgeon River at about fifteen miles from its mouth.

Geological description.

Lower Section. High hills approach the Black Sturgeon River upon the west side, beginning to the southward at a point about eight miles from

Upper Copper rocks.

the mouth, and continuing at distances varying from less than one mile to more than three miles from its banks, to within two or three miles of the lowest lake. Those nearest to Black Bay have an elevation of about a thousand feet, but the height diminishes very much in receding from Lake Superior. These hills appear to be composed principally of the reddish sandstones, shales, and indurated marls of the Upper Copper-bearing series, lying almost horizontally, and capped by an overflow of columnar trap of varying thickness. The rocks exposed all along the bed of the lower section of the river, from Black Sturgeon Lake to the mouth, belong, with a few exceptions, to the same series, being principally indurated marls and sandstones. Black trap occurs at the first rapid, one mile and a quarter below the lake, but from this point downward, indurated red marls, with light greenish layers, all lying nearly horizontally, are beautifully exposed along the banks of the river to Nonwatan Lake. At three miles below Esh-qua-nonwatan there is an exposure of dark brownish fine-grained compact felsite, ribboned with lines and patches of reddish and others of greenish color. It dips at a low angle, southward, and resembles some of the beds associated with the Upper Copper-bearing series in the Thunder Bay region, but may be Huronian. An exposure of trap is met with in the bank of the river, just above the main west branch, at about fifteen miles from the mouth, and another at about eight miles from the same point. No fixed rock was observed along the south-west side of Black Sturgeon Lake, except near its head, where black trap occurs on both sides, and continues down the north-eastern shore for seven or eight miles, when Laurentian gneiss is met with. From this point, a considerable area of gneiss stretches along the north-east side of the lake, towards the outlet. High hills of trap rise on the east side of Nonwatan Lake, and continue southward, with more or less regularity, for a distance of about sixteen miles, or to within twenty miles of Black Bay. At about sixteen miles from this bay, the hills on the east side are composed of greenish slates, supposed to be Huronian, striking about N. 70° E., and dipping at a high angle to the northward. From this locality, hills of reddish Laurentian gneiss run close to the river, in a continuous range, varying from five to seven or eight hundred feet in height, for a distance of about six miles towards its mouth. These hills form part of the western boundary of a Laurentian area, extending to the Nipigon, and which will be described in connection with that river.

Brine spring.

Upper Section. No solid rock appears at the southern end of Black Sturgeon Lake, but pebbles of indurated red marl and impure limestone are abundant on the beach. The black trap occurs at the first rapid on the north branch of the upper section of the river, about six miles south-west of the lake. At the head of this little rapid, a brine spring is found on the north bank of the river. It rises among loose masses of the trap, in the immediate vicinity of the same rock *in situ*. Angular fragments of indurated red arenaceous marl, some of them having light spots, were also common in the neighborhood, and it is probable that the brine proceeds from strata of this nature underlying the trap. Small ridges of the latter rock were crossed, here and there, in making two traverses between the north and south branches. It has been mentioned that a range of hills crosses the northern branch at about thirteen, and the southern at about fifteen miles from Black Sturgeon Lake. This range appears to run south-eastward for a considerable distance towards Black Bay. Its eastern flank is composed of dark coarsely crystalline trap. Just behind the east slope of the range, and between the two branches of the river, a small lake is met with, at which, I was informed by the Indians, pipestone, like that of Red Rock, (a light-red argillaceous limestone) occurs *in situ*. The shingle in the bed of the south branch, for several miles east of the trap range, consist principally of fragments of indurated calcareous marls and shales of various colors.

NIPIGON RIVER.

Geographical details.

The Nipigon River empties into the head of Nipigon Bay, which is the most northern point of Lake Superior. It is the largest river flowing into the lake, and differs from all the others in having clear water. The folowing appears to be about the order, in size, of the twelve largest rivers entering Lake Superior, judging principally by the area which each appears to drain: Nipigon, Kaminitiquia, Black Sturgeon, St. Louis (in U. S.), Pic, Michipicoten, Goulais, Batchawana, Black, Ontonagon (in U. S.), Montreal, and Current. The character of the Nipigon River and its size, together with the fact of its draining the largest area tributary to Lake Superior, and connecting this with a lake of such an extent as Nipigon, entitle it to be considered as the continuation of the St. Lawrence beyond Lake Superior. The general upward course of the Nipigon is due north, (astronomically) its mouth and the exit from Lake Nipigon being in about the same longitude. Between these points, however, which are thirty-one miles apart, the river makes a slight curve to the westward. Four lakes occur in its course, to which, in the absence of any other names, we gave those which are shewn on the accompanying map. The lowest of them, Lake Helen, is only one mile from Red Rock, a Hudson Bay Company's post at the head of Nipigon Harbor. At the outlet of this lake the river is very narrow, apparently only about 100 yards wide, and sweeps around with a strong current (estimated by Admiral Bayfield at four and one-half knots an hour) for a distance of about half-a-mile, between banks of boulder-drift, from thirty to forty feet high. Lake Helen, which runs due north

Four lakes.

Lakes and portages.

is about eight miles long and one mile wide. The upward course of the river leaves the west side of this lake nearly at right angles to the shore. For six miles from this point, in a north-westerly direction, it has a width of about five chains, with deep water, and a moderately strong current, flowing in a bed of alluvial sandy clay, with Laurentian gneiss close to the east side, sometimes approaching quite to the brink of the river; while on the west side, the same rock comes to the water towards the end of this stretch. Here the river makes a sharp bend to the right, and is broken by a slight chute at Camp Alexander. At one-quarter of a mile above this point the Long Rapids begin, and continue for two miles; but in ascending the river they are avoided by turning into a brook on the west side, and following it for about three quarters of a mile, and from it a portage of one mile and a-half brings us to the foot of Lake Jessie. This lake, which is three miles long, and studded with islands, is separated from Lake Maria, immediately above it, and two and one-half miles in length, by The Narrows, six or eight chains wide, in which there is a strong current, with a fall of six inches or more.

A very high west-facing cliff of columnar trap approaches the river from the south-westward, at the head of Lake Maria, and runs from this point, in a tolerably straight course, all along the east side of the river to Lake Nipigon. Trap cliffs also occur on the west side of the river from Lake Maria to Cedar Portage, the distance being two miles. This portage is 250 yards long. A mile and a-quarter above it there is another portage, of fifty yards, over an island in the middle of the river. Three quarters of a mile above Island Portage, the One-Mile Portage, (2600 paces) begins. At rather more than one mile from the head of this portage the river breaks in a white foaming chute, across a narrow ridge of trap, which separates Lake Emma from the lower level. A narrow arm, in continuation of the course of the river, just below White Chute, and parallel with the east shore of Lake Emma, but on a lower level, extends beyond the chute to a distance of about a mile, where a portage of 230 yards is made across the low trap ridge to the lake which has just been mentioned. This lake is nearly four miles long. Between it and the point at which the river leaves Lake Nipigon, a distance of some six miles, four principal rapids occur, the lowest of which is seen where the river enters the northern extremity of Lake Emma. The canoe route turns aside from the waters of the Nipigon at the north-west angle of this lake, and for one-quarter of a mile follows a brook flowing from Lake Hannah, which has a slightly higher level than the last lake. Four miles more, in a north-westerly course, brings us to the head of Lake Hannah, from which Flat Rock Portage, about one mile in length, carries us to the shore of Lake Nipigon.

The following list shews approximately the levels in ascending the river, and the height of Lake Nipigon above Lake Superior. The three princi-

Levels.

pal ascents, namely, at the Long, the One-Mile, and the Flat Rock Portage, were determined by observations with two aneroid barometers; the others were estimated as carefully as possible, on the ground.

	Feet.
Current between Red Rock and Lake Helen	2
Current in river from Lake Helen to Camp Alexander, six miles, at one foot per mile	6
Chute at Camp Alexander	4
From the last to foot of Long Portage, by way of Portage Brook	8
Rapids at Long Portage	137
Current in The Narrows, between Lakes Jessie and Maria	½
Current from last lake to Cedar Portage	1
Cedar Chute	10
Current from Cedar Chute to Island Chute	1
Island Chute	7
Current from the Island to the One-Mile Portage	2
Rapids at One-Mile Portage	45
Current from One-Mile Portage to White Chute	1
White Chute	6
Current in brook between Lakes Emma and Hannah	1
Rise from last lake to Lake Nipigon, (Flat Rock Portage)	81½
Lake Nipigon above Lake Superior	313

Geological description.

Red marls and trap.

From a cove on the west side of Nipigon Bay, about four miles south of Red Rock, a belt of level sandy ground, which is swampy in some places, runs westward to the Black Sturgeon River. Hills of columnar trap, resting upon the indurated red marls and associated rocks, rise both to the north and south of this level tract, near Nipigon Bay, but they do not extend far westward. Near the Black Sturgeon River an isolated hill rises from the level ground. On the sides of this hill the red marls are frequently exposed, while the summit appears to be composed of trap. The hills of gneiss, which have been mentioned as running down the east side of the Black Sturgeon River, terminate at about ten miles from its mouth. From this point the southern limit of the Laurentian area runs northeastward to within about a mile of Red Rock, where the black trap is found resting upon horizontal beds of a gray shaly arenaceous rock. On the west side of the Nipigon the hills of gneiss approach the river between Lake Helen and Camp Alexander, and continue northward for some miles along the west side of Portage Brook, which joins the river on the lower side of the Long Portage. The whole country, from this section of the Nipigon River south-westward to the Black Sturgeon, as far as it is known, is composed of Laurentian gneiss, in a succession of high ridges, the depressions between them being generally occupied by long ponds or marshes.

Gneiss.

Mica schist.

On the east side of the river, in ascending from Lake Helen, the gneiss at first dips northward at an angle of about 70°, but soon changes to the opposite direction, the synclinal axis being about two miles from the lake. Beyond this the dip is uniformly northward, at high angles. The trap begins at Camp Alexander, and continues up the west side of the river, and of Lake Jessie, while gneiss, with a north-eastward dip, occupies the eastern side of the lake. At the head of the Long Rapids the trap, which is seen resting upon the gneiss, is close-grained and compact, while further away, on the east bank of the Portage Brook, it is of a coarser texture, and thickly spotted with crystals of whitish feldspar. The land is low on the western sides of Lakes Jessie and Maria, but somewhat hilly to the east of them. Gneiss occurs at the Narrows, between these two lakes; and on the east shore of Lake Maria, a short distance northward, there is a considerable display of mica-schist, dipping N. 10° E. $<$ 45°. Overlying this, at the north-east side of the lake, and just under the high trap bluff already referred to, there is a great thickness of quartzite, probably Huronian, dipping N. 20° E. (mag.) $<$ about 80°. Above this lake the river passes for two miles through a gorge in the trap. Mica-schist, holding an abundance of garnets, and running N. 50° E. (mag.), begins at Island Portage, one mile and a-quarter farther up, and continues to the One-Mile Portage, beyond which the black trap was the only rock seen *in situ* to the shore of Lake Nipigon, following the canoe route by the Flat Rock Portage. At the north-west end of Lake Hannah angular fragments of a hard coarse-grained gray sandstone are abundant, shewing that the parent rock is not far distant.

LAKE NIPIGON AND THE SURROUNDING COUNTRY.

Lake Nipigon.

Nipigon, the name by which the lake is commonly known, is a contraction of an Indian word signifying "Deep Clear-water Lake." Our plan of operations in making the survey has been already explained. The general outline of the lake we found to be elliptical, the longer diameter lying a little west of north, and measuring about seventy miles, while its breadth is about fifty miles. The shore is, however, deeply indented by large bays, especially on the south side. Ombabika Bay, on the north-east side, is the largest in the northern part of the lake, being nearly twenty miles long, with an entrance only one mile wide. These indentations add greatly to the length of the coast-line, which measures 580 miles, without following the smaller bays and coves. This circumstance will, no doubt, be of much advantage in colonizing the land surrounding the lake, since it renders so much of it accessible from the water.

Lake Nipigon.

Nipigon differs from the other great lakes in being thickly studded with islands, adding much to the beauty of the landscape. It has been already mentioned that in the course of our survey we ascertained the size and position of about 460 of the islands, and located approximately about 100 more. These vary in size from eight miles, in their principal diameter, down to a few chains in length, but the numbers stated do not include any mere rocks, destitute of trees. Many islands, at a long distance from shore, could not even be located. Probably the whole number in the lake exceeds a thousand. Four of the largest islands range from five to eight miles in diameter, while others, measuring between two and three miles, are numerous.

The Nipigon River, which issues from the south-east side, is the only outlet of the lake. I have referred to the fact that, many years ago, according to the Indians, a small quantity of the water escaped into Black Sturgeon Lake. From our observations along this river, it would appear, as already stated, that the surface of the lake is about 313 feet over Lake Superior. The shores are generally bolder, and the water deeper on the southern and western sides than on the northern and eastern, where long sand-beaches and shallow bays are of frequent occurrence. Mr. William Armstrong, of Toronto, who visited Lake Nipigon in 1867, states that close to Echo Rock, a line 540 feet long was lowered without reaching the bottom. Although we did not actually ascertain the depth anywhere at a distance from land, it always appeared to be very considerable, and I have observed the Indians fishing in upwards of a hundred feet of water, within a stone's throw of the shore.

The following are the names, in order of apparent size, of the sixteen largest streams flowing into the lake, and their positions are shown on the accompanying map: Kay-oshk or Gull River, Na-me-wa-min-i-kan or or Sturgeon River, sometimes also called the Poplar Lodge River, from the name of the Hudson Bay Company's post at its mouth, O-na-ma-ni-sagi or Red Paint River, Pick-i-ti-gouch-ing or Muddy River, Ka-bi-to-ti-quia or the river which runs parallel to the shore, Om-ba-bi-ka or Rising Rocks River, Wa-ba-nosh or Dawning Day River, Ka-ma-ka-te-wa-ga-mig or Black Water River, Posh-ko-ka-gan River, Ka-wa-ba-ton-gwa or White Sand River, Ka-ba-sash-kan-da-gi-sino River, Pa-jit-chig-a-mo or Look-out River, Sandy River, Katch-an-ga-ti-na-wi or High Hill River, Ka-nee-sha, and Ka-nee-sha-sing River.

The aspect of the country immediately around Lake Nipigon, and of the islands within it, is undulating and sometimes hilly, although level tracts of considerable extent occur in some places, and will be again referred to in describing the soil. The most prominent or noted elevations near the lake, are those of Three Mountain Point near Flat Rock

Lake Nipigon.

Portage, Grand Cape, the hills on the south-east end of Grand Island, Tchiatang's Bluff on the east side of Black Sturgeon Bay, a low range terminating in Echo Rock near Nipigon House, Mount Royal on Jackfish Island (so called from its resemblance to Montreal Mountain), the Inner and the Outer Barn, Mount St. John, and the Sugar Loaf. The height of Echo Rock we found to be 241 feet above the lake, of the Inner Barn 622, and of the Outer Barn 574 feet above the same level.

In regard to geographical names, we endeavored to ascertain all those used by the Indians, both in reference to places on Lake Nipigon itself and in the surrounding country. These we always adopted in preference to any others. For the correct meaning and mode of spelling the Indian names, I am indebted principally to Mr. Henry De La Ronde, of Poplar Lodge. There are, however, many geographical features for which the Indians appear to have no distinctive names. When names of any other origin existed for these, we always adopted them. There still remained many localities for which we could hear of no designation whatever, and it then became necessary, for the convenience of description, to give names to them.

Geological description.

East Side.—The following geological description of the eastern side of Lake Nipigon from Flat Rock Portage, on the south side, to Meeting Point, at the northern extremity, is taken from Mr. McKellar's plans and notes.

Trap rocks.

Following the shore eastward from the portage, the only rock to be found, with the exception of an exposure of limestone, about to be noticed, is the black or dark gray columnar trap, supposed to belong to the crowning overflow (12); until reaching a cove one mile north of Black Water River, where Huronian rocks begin. On Columbus Point and Prince Alfred's Island, which lies close to it, the trap is coarsely crystalline and contains much magnetic iron. It is cut by numerous ill-defined veins of bright red orthoclase feldspar, holding grains of semi-translucent quartz. In the vicinity of the outlet of the Nipigon River the shores are bold, rising from 50 to 200 feet above the lake, with but little soil. Both fine and coarse grained varieties of the trap occur here; the weathered surface of the latter often shewing large crystals of black pyroxene. East of the outlet a deep narrow bay, forming the south-eastern extremity of the lake, and called by the Indians Pi-jit-a-wa-bi-kong, runs southward parallel with the river. The ground is bold and rocky on each side of this bay, and rises to heights varying from 100 to 300 feet above the lake; while a prominent point on the east side, called Green Mountain, rises to a height of upwards of 400 feet.

Limestone.

The limestone which has just been referred to, is met with on the east side of Cook's Point, two miles west of the outlet, where it extends for a mile along the shore, and in some places rises from fifteen to twenty feet above the water. It is thinly bedded, and consists of alternating whitish and olive-green layers. The rock, which has a fine homogeneous texture and conchoidal fracture, is magnesian and argillaceous, and when burnt would probably form a good cement. Some indistinct forms, resembling fossils, occur in it, but nothing definitely organic was observed. The limestone band is generally horizontal, but in some places it is thrown into a series of small anticlinals, having their axes north and south. It is overlaid by the trap, which rises to a height of about 100 feet immediately above it. Near the contact of the two rocks the limestone is somewhat altered, being white and crumbling, as if calcined, while the trap holds reddish, greenish and dark brown nodules and veins, together with small veins of white calc-spar and quartz. For a space of ten or twenty feet above the limestone, the trap is filled with red specks of oxide of iron, probably resulting from the pyrites which commonly prevails in the rock.

Huronian rocks.

From the bottom of the cove at which the Huronian rocks begin, a valley runs eastward from the lake, and is overlooked on the south side by a trap bluff, nearly 300 feet high. The rocks occupying the lower ground to the north, consist of dioritic slates, dipping generally N. 25° W. (mag.) < 83°. Some of the beds are made up of elongated masses, running with the stratification, and varying from a few inches up to one or two feet in their longer diameters. The inclosed masses are harder and more compact than the slaty matrix, but otherwise have much the same character and appearance. Quartz veins, running with the stratification, are very numerous. They are of a lenticular form, generally diminishing rapidly in thickness each way. Where one vein ends another usually begins at a few feet on either side of it. The largest are four or five feet thick in the middle. The quartz has a barren appearance, and nothing of a metallic nature was observed in any of the veins. Many of the slate beds on each side of them are chloritic, and have smooth shining surfaces. These Huronian rocks extend to the bight of the bay on the south side of Grant's Point, a distance of two miles and-half. Here the trap again makes its appearance, and occupies the shore to the south side of Sandy River, but it does not appear to extend far inland.

From this river the dioritic slates continue for five miles, terminating at a cove, three miles in a straight line, north of Poplar Lodge, which is at the mouth of the Na-me-wa-min-i-kan River. On the north side of Sandy River, they appear to dip southward at an angle of 45°, and at Poplar Lodge, N. 55° W. < 85°. In the vicinity of Poplar Lodge, besides the ordinary diorites and dioritic slates, there are chloritic slates and dioritic slate-conglomerates. The enclosed masses in the last mentioned rock are both rounded and angular, and vary in size from small pebbles to boulders or fragments six inches in diameter. They are lighter in color than the matrix, and shew more distinctly on worn surfaces, especially when wet, than in fresh fractures.

From the above mentioned cove, three miles north of Poplar Lodge, the trap occupies the shore to a bay seven miles farther on. At the bottom of this bay a green slaty rock, supposed to be Huronian, makes it appearance, and is followed by quartzite, which may belong to the same series. The quartzite is sometimes interstratified with irregular beds of greenish chloritic and dioritic slates, and broad bands of a red granitic rock. The strike in this neighbourhood varies from about east to south-east, and the dip is vertical. For two or three miles south of Livingstone's Point, the rocks are of a gray gneissoid character, and are often cut by granite veins, running in different directions. Livingstone's Point, which is five miles long and from one to two miles wide, is composed of trap, rising to the height of 200 or 250 feet on the north side.

Gneiss.

Granite veins.

The rock, both of the islands and the main shore in the eastern part of Humboldt's Bay is gneiss, mostly fine-grained and compact. On a small island two and a-half miles south-west of the mouth of the O-na-ma-ni-sagi River, which enters the bottom of the bay, the gneiss dips northward at an angle of about 80°, and is composed of whitish quartz and fedlspar, with black mica so arranged as to give the rock a schistose appearance. It is cut by a great number of branching and reticulating veins, varying from half-an-inch to one foot in thickness, and belonging to three distinct sets, the newer cutting those of older date. They are composed of red feldspar, white quartz and black mica. The newest set is coarsely crystalline, and contains but little mica; the oldest is the least crystalline, and contains mica in sufficient quantity to give it a dark color; while the second set is intermediate between them in both respects. On an island lying one mile west of the mouth of the O-na-ma-ni-sagi River, regularly stratified gneiss, in which hard slaty micaceous beds predominate, dips N. 14° E. (mag.) $<75^\circ$, and rests upon a massive granitic rock. Thin, somewhat granular quartz layers or veins in the micaceous gneiss, on the west end of this island, carry copper pyrites. A few trap dykes cut the gneiss on some of the islands in the eastern part of this bay, their courses being between north and north-west. The largest one observed is about fifty feet thick. Dykes are rare on the shores of Lake Nipigon, only a few besides those in this locality having been observed. Along the north side of Humboldt's Bay the gneiss is overlaid by trap, which appears to occupy a considerable area in this neighbourhood.

Both the southern and northern extremities of the South Peninsula of

Ombabika.

Ombabika are composed of trap, the central portion being occupied by reddish coarsely crystalline granite or granitoid gneiss, with trap on some of the points and islands on the west side. Sandstone of a light gray color, rather fine-grained, hard and quartzose, occurs on the shore in three or four places between five and six miles south of the entrance to Ombabika Bay. It flanks the granite, and strikes northward with the shore, dipping eastward at an angle of 15° in one place, and at another westward into the lake, at an angle of 80°. Trap, in the form either of beds or great dykes, is associated with it.

Ombabika Bay is nearly twenty miles long in a north-westerly direction. Viewed from the opposite shore, the country all along its north-eastern side, appears level and covered with green wood. Gneiss occurs near the mouth of the Ombabika River, and on a low islet about a mile north-west of it, and again on a point eight and a-half miles north-west of the river. In all of these localities it is intersected with small granitic veins, and at the one last mentioned, shows on the surface very distinctly the outlines of angular pieces of syenite imbedded in the mass.

Ombabika River.

In ascending the Ombabika River, Mr. McKellar made three portages around rapids or chutes of about ten, thirty and twenty-five feet fall, respectively; the last being about two miles in a straight line from the lake. Above this, the Indians informed him that no more portages occur for a long distance, and that the river passes through a lake lying seven or eight miles from its mouth in an easterly direction. The Indians all agree in describing the Ombabika River as flowing through a level country. It is said to rise in a lake three miles long, from which a stream also flows into the Albany River. From the mouth to the third fall the banks are from forty to eighty feet high, the lower portion being a calcareous blue clay, and the upper a mixture of sand and clay; while above this fall the surface of the country appears to maintain the same general level as below it, the banks only rising from ten to twenty feet over the river. The soil is excellent, being a dark-colored crumbling loam, free from boulders, and supporting a thick growth of tall, but not large spruce, balsam, tamarac, poplar and white birch trees. The rocks at the third fall are gneiss, with beds of a white granular quartz holding occasional scales of mica and crystals of iron pyrites. The portage is 390 paces long, and appears to be much used by the Indians. At the lower end the gneiss dips S. 40° W. (mag.) < about 45°, and at the upper, where the bedding is very distinctly marked, S. 30° W. (mag.) < about 60°.

The north peninsula of Ombabika, about twelve miles long, appears to be composed entirely of trap. Between this peninsula and Meeting Point the country north of the lake seems to be all trap, rising in hills, sometimes 300 or 400 feet high, while some points on the lake shore consist of gneiss

Lake Nipigon.

having generally a north-western strike. At one place, a short distance east of Meeting Point, the rock consists of epidosite, beautifully banded with shades of a darker and lighter green. In the same neighborhood a fine-grained variety of the trap is cut by small veins of thomsonite.

Columnar trap.

West Side.—Starting again at Flat Rock Portage, the fixed rocks of the whole shore, and of the islands, as far as they came under our observation, consist of the black or dark greenish-gray trap, with a few exceptions, which will presently be described. The trap is generally crystalline, coarse-grained massive and columnar, and contains, in addition to the feldspathic and augitic minerals, magnetic iron and iron pyrites. Under the influence of the weather, much of it becomes friable, and crumbles into gravel-like pieces, and eventually into soil. The process is no doubt aided by the decomposition of the pyrites, which is present, often in considerable quantities. This circumstance, and the columnar character of the trap, account for the peculiar effects arising from its denudation, producing an irregular and generally rocky coast-line, and many islands, with deep water around them, combined with good soil on the land. The trap is so strongly magnetic as to render the compass generally unreliable, and often totally unserviceable in its neighborhood. The coarse-grained varieties were observed to be more strongly magnetic than those of a finer and more compact character. When not strongly affected by local attraction, the variation of the magnetic needle ranged from 2° to 6° east of the true meridian. Where the bedding is distinct the surfaces often present reticulations resembling those formed in mud left by the drying-up of pools. These are marked, either by a difference in the color or in the character of the rock, causing them to weather out more rapidly than the rest of the mass. Distinctly marked stratification is, however, of exceptional occurrence, so that we were unable to determine the general structure and arrangement of the rocks throughout this great trap region. The first place at which well-marked bedding was noticed, occurs on the west side of Long Point, where, at about three miles south of the extremity, the beds, which are from one to four feet thick, and exhibit the reticulating crack-marks, dip westward into the lake at an angle of about 70°. On a small islet close to the shore at this locality, numerous small veins following the joints in the trap, are filled with flesh-coloured thomsonite.

On the east shore of Black Sturgeon Bay, from the commencement of the narrow arm leading to the portage, for a distance of about two miles, the trap is interstratified with beds of argillite, felsite and sandstone, all on edge, and running in a northerly direction. These rocks appear along the margin of the lake, at the foot of Tchiatang's Bluff, 400 or 500 feet high, which runs for four miles along the south-east side of this bay; but their relation to the great mass of trap constituting this bluff was not determined. Some of the felsite beds are soft greenish and earthy; others harder and schistose. The argillite is hard dark colored and compact, with a conchoidal fracture; while the sandstones are light-colored and soft. One bed of the latter, of a very light greenish-gray color, is composed of fine silicious and argillaceous particles, with scattered grains of translucent quartz. High bluffs of trap continue down the east side of the arm towards the north-west extremity of Black Sturgeon Lake. Under these cliffs, at a distance of half a mile from the open bay, there is a band of light-gray tender harsh-grained sandstones, about 100 feet thick, dipping S. 80° W. (mag.) $<$ 50°, which appears to come between great masses of the coarse crystalline trap. Two miles further south, or about a quarter of a mile north of the extremity of Black Sturgeon Lake, beds of a coarse light-gray sandstone, holding occasional pebbles, mostly of white quartz, are found lying against the side of a hill of gray splintery schistose felsite. The sandstone dips south-westward at an angle of about 40,° while the felsite dips in the opposite direction, with an inclination of about 60°. At the point on the south-west side of the Narrows, at the entrance to Chief's Bay, the trap is in beds from one to five feet thick, dipping north-eastward into the lake at an angle of about 40°.

Lake Nipigor.

On the opposite side of the Narrows, which are half a mile wide, the trap is overlaid by compact argillaceous magnesian limestone, with a conchoidal fracture, dipping S. 25° W. (mag.) $<$ 5°. The beds are from three inches to two feet and a-half in thickness, and present different shades of a grayish and olive-green color. Although the section exposed does not appear to exceed ten feet in thickness, so regular and slight is the dip that these rocks extend for a quarter of a mile along the shore, and are seen along a brook to the north-westward, and in the bottom of the lake in front. Small pear-shaped bodies, about the size of peas, weather out on the surfaces of some of the beds, but they show no organic structure, either outwardly, or in sections examined under the microscope. The same olive-green limestone occurs again on the north-east shore of Chief's Bay, about two miles from the Narrows. The beds are from six inches to two feet thick, and dip S. 40° W. (mag.) $<$ 8°. A section of six or eight feet is exposed, and the strata are underlaid conformably by beds of fine-grained compact black trap, shewing crack-marks on the surface. Similar trap is met with, in thin beds, only from six inches to one foot in thickness, at the foot of the first rapid on the Poshkokagan River, about three miles south of its mouth, which is at the southern extremity of Chief's Bay. The dip is here N. 60° W. (mag.) $<$ 5°. On the west side of the river, at this rapid, a bank, composed of gravel, sand, loam, clay and boulders, rises to the height of sixty or seventy feet. On its side, and in the bed of the stream, are many angular fragments, some

Limestone.

of them of large size, of gray, red, darker and lighter green and mottled sandstone and indurated marl, and others of a soft white marly limestone; which, my Indian guide informed me, occurs *in situ* on this river at about thirteen miles, in a straight line, south of its mouth. The same man pointed out to me a spot on the west side of the Poshkokagan, about half a mile below the first rapid, at which a spring of brackish water issues from the mud, when the river is low.

Gneiss.

A small island, only a few chains in length, lying at the bottom of Grand Bay, and about one mile north of Tchiatang's Bluff, is composed of coarse light gray gneiss, consisting of quartz, feldspar, and a little mica, with a few thin interrupted bands of mica-schist. The stratification is vertical, and runs about N. 85° W. (mag.) The trap nearest to this island is very fine-grained, tough and compact. This was the only exposure of gneiss observed around the whole of the southern and western shores of the lake, as far as Wabinosh Point; unless, indeed, some patches of white-weathering rock, which were observed behind the shore, near the south side of West Bay, should prove to be Laurentian. The gneiss begins on Wabinosh Point, at one mile north of the bay of the same name, and continues in a low narrow strip along the shore, for a distance of one mile and three-quarters, and is overlaid by the trap, which rises in cliffs 300 feet high, immediately above it. The rock is of a light gray color, and composed of white quartz, feldspar, and black mica, with strings of epidote. Mica-schist and coarse red feldspar-rock are associated with it in one place. The general dip is S. 15° E. (mag.) $<$ 65°. Gneiss is again met with on several small low points and islands, for three miles along the shore opposite Windigo's Islands, in the north-western part of the lake. It is of the same character as the last, and like it, contains, occasionally, patches of mica-schist and of coarse red crystalline feldspar. In the distance mentioned, the bedding appears to have a synclinal form, dipping north at an angle of 30° in the south part, and south at an angle of 45° in the northern; being evenly stratified in both localities, but somewhat disturbed in the central part. The most northern of Windigo's Islands is composed of gneiss, the others of trap. The north shore of Windigo's Bay is low, and the country behind, level, with three isolated conical hills rising from it, within sight of the lake. The most remarkable of these is the Sugar Loaf, about 300 feet high, and lying at a distance of two miles and a-half northward from the mouth of the Pickitigouching River. This river was surveyed for a distance of four miles and a-half from the mouth. The only rock met with was a small hill of trap on the west side, at two miles from the lake. The high ground on Meeting Point, on the east side of Windigo's Bay, consists of trap, which is mostly fine-grained near the shore, while the islands at its extremity, and some of the small points to the north-eastward, are composed of gneiss. The latter rock is mostly of a hard gray massive variety, made up of whitish quartz and feldspar, with black mica. The last mentioned mineral is abundant in some places, and the whole rock occasionally passes into mica-schist. In the more quartzose portions, epidote occurs in strings and disseminated particles. The dip is generally north-eastward. On the north point of an island three quarters of a mile west of the extremity of Meeting Point, there is an irregular vein of white quartz, a few inches wide, running N. 50° E., and carrying specular iron and crystals of green epidote.

Lake Nipigon.

Feldspar-porphyry.

The lake shore, and the islands from the Hudson Bay Company's farm at Nipigon House, to English Bay, a distance of three miles, are occupied by a brick-red porphyry, composed of crystalline red orthoclase feldspar, with grains of translucent quartz, enclosing finer stratified patches of the same color, and others of white quartz. It also holds spots of a soft green earthy mineral, and small cavities lined with crystals of feldspar. A point on the west side of Jackfish Island is also composed of this red rock. In some places it is broken into regularly shaped blocks of a convenient size for building.

Sandstone.

The shore, just below Nipigon House, is covered with angular blocks and slabs of very evenly bedded, rather fine, free-grained sandstone. In one of the fields, just south of the house, a considerable number of large angular masses of the same rock occurs. It is mostly of a rich, dark reddish-brown color, and being easily worked, would make a fine building stone. Some of it splits beautifully into very even and parallel-surfaced slabs, which would form excellent flagstones. These thinly bedded portions consist of alternating reddish and grayish layers, each only a few inches thick. We were informed that an excavation, which had once been made near the shore at this place, shewed some beds of the sandstone lying horizontally, *in situ*. Angular fragments of coarse gray sandstone with ripple-marked surfaces, and of a soft friable ashy gray argillaceous rock are numerous at Nipigon House.

Dog Island, lying in front of Nipigon House, and separated from the mainland by a channel a quarter of a mile wide, is composed of fine-grained black trap, apparently lying almost horizontally. On the mainland opposite the south end of Dog Island, fine-grained black trap also occurs, and dips S. 20° E. (mag.) 5°. Mount Royal, on Jackfish Island, is about 400 feet high, and consists of trap, which is fine-grained near the junction of the red porphyry, on the west side of the island. The stratification appears to be nearly horizontal, and the worn surfaces of some beds on the shore exhibit closely reticulating crack-marks, very conspicuously. The most northern island in English Bay, and the point between this bay and Wabinosh Bay, consist of the black trap. The red porphyry, and also the sandstone of this locality, would therefore appear to be overlaid to the south, east and north by this rock.

Wabinosh Lake.

A survey was made of the lower Wabinosh Lake, and of the river connecting it with the head of the bay of the same name. The trap hills around Wabinosh Bay, and the lake just mentioned, are from 400 to 500 feet high; while the Inner Barn, with its sides of columnar trap, rises like a great castle, in the middle of the bay, to a height of upwards of 600 feet, and appears to be the highest point around Lake Nipigon. The Outer Barn, four miles east of the others, and having much the same appearance, we found, by means of the aneroid barometer, to be 574 feet in height.

Geological notes.

Judging from the descriptions and sketch-plans obtained from the Indians, the country drained by the streams from the south-westward, flowing into Lake Nipigon, and the region for a considerable distance west of the Black Sturgeon River, is occupied principally by the black trap and red marls or sandstones of the Upper Copper-bearing series. According to the same sources of information, the black trap, interrupted by occasional areas of Laurentian rock, extends to a still greater distance westward from Lake Nipigon, and is followed by flat-lying limestones. From the description by Dr. Bigsby (*Jour. Geol. Soc. Lon.*), I should judge that the high islands which he observed in Whitefish Lake, between Lonely Lake and the Lake of the Woods, consist of columnar trap, like that of Nipigon. I understand that Mr. McTavish, of the Hudson Bay Company, has observed limestone with abundance of fossils around Lonely Lake, on the English River; and my Indian guide assured me that he had seen a rock, which, from his description, I judged to be of the same character, opposite a Hudson Bay Company's post on the Kon-a-don-wen-gwak, or Sand Lake, on the Albany River; apparently in a position corresponding with the north-eastern extremity of the so-called "Lake St. Joseph," of some maps. He also informed me that he had seen black trap, similar to that of Lake Nipigon, on the Albany River, both above and below the place at which the limestone occurs; and limestone again below the lower locality of the trap, or between it and Martin's Falls. I learn from Mr. Geo. Barnston, formerly of the Hudson Bay Company, that gneiss crosses this river at Martin's Falls, below which the unaltered strata, referred to by Sir John Richardson, continue to the sea. From the descriptions of the Indians, it would appear that a gray limestone occurs along the upper part of the Ombabika River, which, as already stated, they describe as flowing through a level country.

It would therefore seem that between Lake Superior and the palæozoic region around James's Bay, there is a complete break in the continuity of the Laurentian and Huronian range. A part of this interval is occupied by Lake Nipigon and the surrounding country. The true age of the Upper Copper-bearing rocks of this region may perhaps be most easily determined by tracing them to their contact with the fossiliferous palæozoic strata to the north or north-west of Lake Nipigon.

Overlying trap.

The trap rocks of Lake Nipigon, and the country between it and Lake Superior, probably belong, partly to the eleventh division of the list which I have given, on page 318, and partly to the crowning overflow. This may be regarded as the newest rock of the whole region, since no strata have yet been found lying upon it, either in the Nipigon district, or around Lake Superior; while, on the other hand, it is found resting in different places, upon almost all the other rocks of the country. The following list of those rocks with which the trap overflow has been seen in contact, recapitulates briefly a number of examples already mentioned:

Contacts.

1. Laurentian gneiss, at the Long and the One-mile Portage on the Nipigon River; on the north-east side of Black Sturgeon Lake; and at the numerous localities which have been mentioned in the northern part of Lake Nipigon, from Wabinosh Bay to Livingstone's Point.
2. Huronian slates in various places on the east side of Lake Nipigon, from Black Water River to Livingstone's Point; and also on what appear to be Huronian quartzites at the north-east side of Lake Maria.
3. Cherts, shales, etc., (2 and 3) of the lower portion of the Upper Copper-bearing rocks, south of the Kaminitiquia River, and along the coast of Lake Superior from this river to the boundary line.
4. Argillaceous sandstones (4) of the same group, on Thunder Cape.
5. Dolomitic sandstones and conglomerates (5) of the same group, on Wood's location.
6. Red argillaceous limestones on the east side of Nipigon Harbor, near Red Rock.
7. Red marls on the west side of Nipigon Harbor, and in the isolated hill which has been mentioned as occurring near Black Sturgeon River, on the portage from Nipigon Bay.
8. Red marls, shales and sandstones along the lower section of the Black Sturgeon River.
9. Flaggy arenaceous and silicious gray shales, a short distance west of Red Rock.
10. Brick-red quartziferous porphyry, and probably red and gray sandstone, at Nipigon House.
11. It is also found, apparently in contact, with the trap, sandstones, argillites, soft greenish and gray splintery shaly felsites, occurring from the east side of Black Sturgeon Bay, on Lake Nipigon, to the northern extremity of Black Sturgeon Lake.
12. Also, apparently, with the rocks of the eleventh division, in the

peninsula between Black Bay and the main body of Lake Superior, forming some of the higher points, such as The Paps.

SURFACE GEOLOGY.

Except in the Laurentian region around Dog Lake, the surface of the country examined does not generally present a rounded or mammillated appearance. This is owing to the fact that the greater part of the area is occupied by the Upper Copper-bearing rocks, which, being of unequal hardness, and with a stratification approximately horizontal, give rise, by denudation, to level tracts and vertical cliffs.

Glacial striæ.—The glacial striæ belong to two sets, one running westward and the other southward. Around Lake Nipigon, the two sets often intersect each other, the one having a western course being the more recent. The following table gives a number of examples of the courses observed in different places, the directions being referred to the magnetic meridian. The variation averaged about 5° east of the true north.

Ice grooves.

		Older set.	Newer set.
1.	Red River Road, 10½ miles from Thunder Bay	S. 25°E.	....
2.	do do 13 do do do	S. 25°E.	....
3.	do do 5 do do do	....	About W.
4.	Mining-lot H, township of McIntyre		S. 75° W.
5.	Kaminitiquia River at intersection of Red River Road		S. 75°W.
6.	South side of Dog Lake		S. 70°W.
7.	Near north end of Lake Maria on the Nipigon River	About S.	....
	Lake Nipigon.		
8.	North-west side of McIntyre's Bay, near portage		S. 65°W.
9.	Extremity of Long Point on east side of Grand Bay		S. 70°W.
10.	Small island at the bottom of Grand Bay		S. 70°W.
11.	Isd. on W. side Grand Bay 4½ miles N. of Tchiatang's Point	S. 10°W.	S. 60°W.
12.	Point do do 7 do do do		S. 75°W.
13.	West side of entrance to Gull Bay		S. 80°W.
14.	Rocking-stone Isd. between entrance to Gull Bay and West Bay		S. 80°W.
15.	Small island in the same vicinity		S. 85°W.
16.	Largest island in West Bay		S. 85°W.
17.	North end of Dog Island, opposite Nipigon House		S. 80°W.
18.	Point on west side of Jackfish Island		S. 80°W.
19.	Shore opposite Windigo's Islands		S. 60°W.
20.	W. side of Britannia Island, S. W. of Meeting Point	S. 30°W.	....
21.	Extremity of Meeting Point		S. 75°W.
22.	Island two miles W. of entrance to Ombabika Bay		S. 55°W.
23.	Southern extremity of S. Peninsula of Ombabika	S. 13°E.	S. 65°W.
24.	Point about two miles north of Poplar Lodge	S. 5°W.	S. 55°W.
25.	Poplar Lodge Point	S. 10°W.	S. 60°W.
26.	Point 3½ miles south of Poplar Lodge		S. 85°W.
27.	Columbus Point		S. 45°W.

Ice grooves.

On the east side of the northern extremity of Lake Maria, the grooving is well seen in horizontal lines, up to a considerable height above the water, on the side of a perpendicular cliff facing west. Grooves were observed slanting, first downward, then upward, forming a regular curve, on the face of a vertical wall of trap on the west side of Grand Bay, Lake Nipigon. At one place in the same vicinity, where the grooves shoot up a very steep slope, rising out of the lake, they were observed to diverge in a fan-like form, from a depression in the surface of a rock. Around the point between English and Wabinosh Bays, where the shore is bold, and the water deep, the striæ run westward, up very steep inclinations, in some places approaching the perpendicular ; in which cases the grooves are short, and the rock has a battered appearance. Occasionally the steep grooved surface has a curved form like that of a plough-share. The westward course of the more recent set of grooves will account for the greater general depth of the western side of Lake Nipigon as compared with the eastern; while the north and south bays of the southern side may have been eroded by the agencies which produced the southward set of grooves. The large angles at which the two sets of striæ often intersect each other, on even surfaces, is a fact worthy of note in regard to the question as to whether the grooves were produced by glaciers or icebergs.

Drift.

Drift.—Boulders and pebbles derived from the Upper Copper-bearing rocks of the peninsula between Black and Thunder Bays, have been strewn over the surface of the older formations in the country immediately west of the latter bay; just as the *debris* of the Lower and Middle Silurian rocks has been carried westward over the higher strata of the western peninsula of Ontario. On the west side of the Kaminitiquia, at the intersection of the Red River Road, boulders, with a small admixture of finer material, are thrown up in conspicuous ridges and hillocks at the base of the hills, which rise to the height of about 400 feet immediately above them. These accumulations appear to have formed the terminal moraines of glaciers proceeding from the valley of Strawberry Brook, directly opposite.

Around Lake Nipigon the materials of the drift have also evidently travelled westward. On the north side of Wabinosh Bay, great boulders from the low gneissic area already described, have been carried in this direction, and scattered upon the overlying trap. One of these, resting upon a hill-side on Wabinosh Point, a quarter of a mile back from the shore, measures twenty feet in diameter, and is distinctly seen as a white spot, from the level of the lake, at a distance of seven miles. All along the north-west shore of the lake, from Wabinosh to Windigo's Bay, there are numerous boulders of fine-grained hard light-gray quartzose sandstone, broadly ribboned with lighter and darker shades of pink. Some of them

Erratic blocks.

are rather coarser-grained than the average, and contain pebbles of white quartz, and more rarely of red jasper. These sandstone boulders have probably been brought up from the bed of the lake, between this part of the shore and the islands to the eastward. Laurentian boulders were seldom seen around Lake Nipigon, except in the vicinity of the same rock *in situ*. Small rounded fragments of light cream-gray limestone, containing a species of *Pentamerus*, were occasionally found on the east side of the lake; and a somewhat angular mass of the same rock, measuring nearly three feet in diameter by a foot and a-half in thickness, was met with on Gneiss Island, at the bottom of Grand Bay. The limestone of this block was very pure, soft, and somewhat porous, and full of rather imperfect fossils, the commonest being a *Pentamerus*, which, Mr. Billings says, is very like some of the forms of *P. galeatus*, but probably a new species. Mr. Billings also recognises amongst these fossils a species of *Favosites*, with small tubes about half a line in diameter, a *Rhynchonella*, and a species of *Zaphrentis*, about one inch in length. He says: "These fossils are not sufficient to determine the age of the deposit from which they were derived, except in a general way. It is not Lower Silurian, and is not so recent as the Middle Devonian. I think it about the age of the Niagara formation." I may here mention that, in 1846, Sir William Logan collected, on the shore of Lake Superior, east of Pic Island, a number of fossils in loose pieces of light yellowish-brown limestone, and some in gray and yellow chert. These fossils have recently been examined by Mr. Billings, who says that they "belong to the genera *Favosites*, *Zaphrentis*, *Streptorhynchus*, *Atrypa*, *Orthis*, *Pterinea*, *Dalmanites* and *Leperditia*. They are Devonian. The only determinable species is *Orthis Iowensis* (Hall), a species characteristic of the Hamilton group in Iowa. It occurs also, far north, on Laird River, and on Snake Island in Lake Winnipegosis, in the same kind of rock,"—a light yellowish-brown limestone. Mr. Thomas Herrick, P.L.S., informed me that he crossed a patch of flat-lying fossiliferous limestone, some two or three miles in breadth, on the Pic River, where his line intersects it, at about thirty-two miles, in a straight line, northward from its mouth. Fragments of olive-green limestone, similar to that described as occurring in place on Cook's Point and the north-east side of Chief's Bay, on Lake Nipigon, were found on Champlain Point and Britannia Island, in the same lake, and on the shore of Lake Superior, near Sucker Brook.

Ridges and Terraces.—On the south side of Dog Lake, terraces of sand and gravel, from fifteen to twenty feet high, are seen in some places close to the present beach. The high ridge crossed by the portage from Little to Great Dog Lake is covered with fine sand. On the north side of the Kaminitiquia, beginning opposite the mouth of the Whitefish River, a regular terrace, apparently of gravel and sand, burnt bare of vegetation, and about forty feet high, runs eastward, close to the river, for a distance of about two miles. A ridge of boulder-drift about forty feet high, crossing the Nipigon at the foot of Lake Helen, near Red Rock, and another, sixty or seventy feet high, at the first rapid on the Poshkokagan River, have been already mentioned. A ridge of sand, with boulders and stones, rising to a height of thirty or forty feet out of a level sandy plain, and running in a westerly direction, crosses the Kabitotiquia River about six miles, in a straight line, south of its mouth. It occasions a small rapid, seventy paces long, over trap boulders, with a fall of four and one-half feet. This is the only rapid from the mouth of the river to a long distance above this point. At Champlain Point, the bank of the lake is about twenty feet high, and composed of loam and gravel, with boulders in the lower part. Some of the latter are Laurentian, which are rarely seen in this part of the lake. A terrace of gravel and sand, rising to the height of 150 or 200 feet above the level of Lake Nipigon, runs for a distance of about two miles along the shore between Echo Rock and West Bay. Having been denuded of timber by some recent fire, these terraces had a very conspicuous appearance as viewed from the lake. A terrace about sixty feet high, composed of very fine white sand, runs for two miles along the shore, northward from the mouth of the Kawabatongwa, and has given rise to the Indian name, which means White Sand River.

Ice movements.

Effects of Recent Ice.—The effects of the spring shoves of lake ice are observable in many places around Lake Nipigon, as well as Lake Superior, in the form of rows of boulders and shingle piled upon the beach, or just between it and the vegetation behind. Where the beach is soft it is often found that each boulder has ploughed a furrow from the margin of the water to its resting place. The rows of shoved boulders were noticed particularly along the west side of Grand Bay, and between West Bay and the entrance to Gull Bay. Very large boulders of trap have been piled, apparently by recent ice, upon the small islands in the latter bay.

None of the abrading effects produced by river-ice during the spring-floods, on the banks, trees and bushes, such as are seen along many of the rivers of Gaspé and the maritime provinces, were observed on any of the tributaries of Lake Nipigon, or upon the Nipigon or Black Sturgeon Rivers.

Sand and Clay Deposits; *Soil.*—In the hilly country around Thunder Bay and Dog Lake, where any soil exists, it is usually a yellowish-brown gravelly loam, with boulders. The sandy tract, underlaid by laminated buff, drab and bluish clay, along the lower reach of the Kaminitiquia River, has been already described, and the existence of nodules in this clay is referred to in the *Geology of Canada*, page 905. Along the greater part of this stretch, the banks, on alternate sides, are from forty to fifty feet high, the upper half being yellowish sand, and the lower clay. The land is low about the mouth of the river, and gradually dips under the lake. The surface is here sandy, but the clay is said to be found at the depth of a few feet, in digging wells, and a similar condition, no doubt, extends below the lake.

In the valley of the upper reach of the Kaministiquia, a stiff red clay begins at four miles below the head of Little Dog Lake, and extends southward to the junction of the Mattawa. From this point it is found along the Red River Road, to a distance of about five miles eastward from the Kaministiquia, gradually rising to an elevation of 400 or 500 feet above its level. On the west side of the river, it is also found on the flanks of the hills above the boulder deposits already described, to the height of about 200 feet above the river, and it is said to extend westward some distance up the valley of the Mattawa.

There is much good land along the north-west side of Black Bay. The country is level and sandy from the head of this bay to Nipigon Bay, and a sandy soil extends up the valley of the Black Sturgeon River. The sand, which is very fine, appears to be underlaid everywhere in these parts by clay.

In the Nipigon country the largest tract of good land appears to lie on the south-western side of the lake. From the Nonwatan River, northward to the Pajitchigamo, a distance of fifty miles, the country is comparatively level, and the soil generally fertile ; but we could not ascertain, from our own explorations, how far westward this tract extends. The Indians and others, however, represent it as continuing nearly to the Winnipeg River, and becoming more generally level in receding from Lake Nipigon. Some of the peninsulas in Lake Nipigon, within the above distance, are hilly, but the soil is generally good, even on these, consisting of a brownish loam, sufficiently tenacious, when moist, to retain its form after having been pressed in the hand. The rivers entering this part of Lake Nipigon, as far as examined, were found to flow, with tortuous courses, between muddy banks of clay, overspread with fine sand. The clay, as seen in the banks, generally appears sandy, from having become mixed with the overlying deposit, but when clean sections are obtained, it is usually found to be stiff, tenacious and free from grit. On the higher levels the sand is often coarser and interstratified with layers of gravel.

There is a considerable area of good land around the bottom of South and McIntyre's Bays, and on the peninsulas east of the latter bay and Gull Bay. From the mouth to the first rapid on the Poshkokagan, the loamy banks of the river are from twenty to thirty feet high. The Kabitotiquia River is so crooked that by following its windings from the mouth

Sand and clay. to the portage leading to Chief's Bay, the distance was estimated to be fully thirty miles, although it is only nine miles in a straight course. The water is deep, and the current slack throughout, except at the slight rapid previously mentioned. In ascending the river the banks rise gradually in height, increasing from a few inches above the level of the water, at the mouth, to five and ten feet, in the above distance. For the first five miles there is a wide open margin on each side of the river, covered with grass. On both sides, the country is level and the soil sandy, supporting a growth of grass and bushes, the timber having been all burnt off by repeated fires within the last few years. The land is free from stones, and very little labor would be necessary to make it ready for the plough.

From the Kawabatongwa River to the Pickitigouching, the country is low, near the lake, and a level [illegible] extends northward to an unknown distance from Windigo's Bay. [illegible] lieved that in this direction a large area is overspread with light-colored clay. During the spring freshets the waters of the Pickitigouching are said to be quite milky from the clay which they hold in suspension, and hence the Indian name of this stream, which signifies the Muddy River.

It has been already mentioned that the country is level, and the soil good, all along the north-east side of Ombabika Bay, and at least as far back from it, in a north-easterly direction, as the eye can reach. Below the first rapid on the Ombabika River, from twenty to thirty feet of the underlying clay are seen above the water; the upper part of the banks, which are from forty to eighty feet high, being composed of sand, sometimes interstratified with clay. The clay, which is in horizontal beds, is free from pebbles or grit, light blue in color, calcareous, sticky and plastic. Above the third portage the river does not cut so deeply into these deposits, the banks being only from ten to twenty feet high. The soil in this region is a dark-colored crumbling loam.

On the south side of the Sturgeon, or Poplar Lodge River, as far as it was examined, the banks, consisting of fine white sand, rise to the height of thirty or forty feet. An undulating sandy country extends for a mile or two to the southward of the river.

The beach sand around Lake Nipigon and Black Sturgeon Lake is often mixed with particles of magnetic iron, probably derived from the trap of the vicinity, but it did not appear to occur in any place in sufficient quantity to be of economic value. Particles of garnet were abundant in the sand in some places in the northern part of the lake.

Climate and Timber.—The climate of the Nipigon country appears to be as well suited for agriculture as that of the greater part of the province of Quebec. Farming has been successfully carried on, for a long time, by the Hudson Bay Company at Nipigon House. The timber around

Forest trees.

Lake Nipigon is principally white spruce, white birch, aspen and poplar, balsam-fir, tamarac and white cedar, with occasional trees of black ash, grey elm, red and white pine. In the month of February last, I had the honor of giving full details on these subjects, in evidence before the Committee of the House of Commons on Immigration and Agriculture, and I understand that they will be published with the report of the Minister of Agriculture.

ECONOMIC MINERALS.

Mineral veins.

The Upper Copper-bearing rocks, all the way from the boundary line to Nipigon Bay, are cut by numerous metaliferous veins. These are so well described in the *Geology of Canada*, pages 74, 75 and 76, that in the present state of our knowledge, little of a general nature can be added. As there stated, the veinstones consist of quartz, which is usually either amethystine, or else white and granular, calc-spar, barytes, and variously colored fluor-spar; and where they cut the higher members of the series, zeolites and other minerals are also frequently present; while their metallic contents embrace "copper, lead, zinc and silver, with more rarely nickel, cobalt, arsenic, uranium and molybdenum." Sir William Logan says, (p. 74) "the indications which they present are such as to render it certain that many parts of the country characterised by them will, sooner or later, rise into importance as a mining region." It is stated on pages 76 and 745, that a little gold had been met with in a vein on Prince's location. Since the *Geology of Canada* was written, Professor Chapman, in April, 1868, found the same metal in larger quantity in the ore of the Lead Hills location near Black Blay. With regard to this ore, he says: "Carefully conducted assays shew amounts of gold varying, per ton, from about 14 to 19 dwts., the mean of those already made giving 17 dwts. 12 grs., with 2 oz. 2 dwts. of silver."

Gold.

In reference to the course of the veins, Sir William Logan says (page 74): "As in the case of the dykes, the mineral veins belong to two systems,—one coincident with the range of the rock masses, and the other transverse to it. They are therefore parallel to the dykes,"—the one system being about N. and S., and the other varying from N.E. and S.W., to E. and W.; or, on an average, E.N.E. and W.S.W. It will be observed that these directions also correspond with those of the two sets of ice-grooves.

The additional information in regard to economical minerals obtained during our explorations will now be given under their respective heads.

Iron.—Reference has been made to the occurrence of a mixture of magnetic iron ore with insoluble matter, chiefly silicious, in the form of a thin-bedded deposit, apparently of considerable extent, and containing, Iron ores.

in the specimen examined, 37·73 per cent of metallic iron. Dr. Hunt says this ore "might be smelted, but would require a large amount of limestone as flux." Mr. H. P. Savigny, P.L.S., of Toronto, has shown me specimens of pure massive magnetic iron ore, which, he says, occurs in large quantities a short distance from the shore of Thunder Bay, near Amethyst Harbor. A specimen of pure botryoidal red hematite was given me, which was said to have been found at Arrow Lake. Chief Manitousaise, of Lake Nipigon, showed me some earthy red hematite, used by the Indians as paint, which he says is found in abundance in a hill on the east side of Lake Nonwatanose. I have seen specimens of hard fine grained red hematite, said to have come from the Red Paint River, and pieces of the same mineral from thin veins, which are reported to exist just behind Nipigon House. Small quantities of specular iron were found in the red gneiss on the brow of the west-facing hills overlooking the Black Sturgeon River, due west from Red Rock, and the same mineral has been referred to as occurring in a quartz vein on an island off Meeting Point. It was likewise observed by Mr. McKellar in small veins, in several places on the lake shore between Poplar Lodge and Sandy River. It has been already stated that the magnetic iron in the beach-sands around Lake Nipigon and Black Sturgeon Lake was in no place found in sufficient quantity to be of economic value. The Indians sometimes mistake the blacker and heavier varieties of the trap for iron ore, and might thus mislead explorers.

Lead ore.

Lead.—A lead-bearing vein was said to have been found last summer, on Stewart's location on the north bank of Pigeon River, about two miles from its mouth; and veins were reported to have been discovered on Lake Kee-zee-zee-kitchi-wag-a-mog and Whitefish Lake. On the north bank of the Kaminitiquia, a vein three or four feet thick, running north-eastward, occurs on the 4th or 5th lot in the township of Paipoonge. It contains barytes, quartz, calc-spar and fluor-spar, with a little copper pyrites, iron pyrites, and galena. In the township of McIntyre, near the north-east corner of Neebing, pieces of similar veinstone, with crystals of galena, were found scattered upon the surface, indicating the near proximity of the vein from which they have been derived. A large vein containing all the above minerals, and also zinc blende, crosses the Paresseux Rapids on the Kaminitiquia, at the intersection of the side-line between lots 20 and 21 of Paipoonge. Mr. Herrick, who surveyed this township in 1859, reports that he observed the same vein some miles to the south of the Kaminitiquia, and traced it, on the opposite side of the river, through the whole breadth of the township. He gives its width as varying from ten to twenty five-feet. It is supposed by explorers to be identical with the lead-bearing quartz vein of the Algoma mine, which has been already mentioned as occurring on the north-west corner lot of Neebing. The

Mineral veins.

Wallbridge mine is on the west half of this lot, and here, a shaft, said to be fifty feet deep, has been sunk on the same vein. Mineral veins of a similar character, and, for the most part, running in a direction approaching E.N.E., have been discovered in a considerable number of localities among the Upper Copper-bearing rocks in the township of McIntyre, and along the north shore of Thunder Bay, and thence to Black Bay. They are too numerous for separate description within the limits of this report, but their positions are shewn upon the accompanying map. The largest vein examined, occurring upon mining-lot M, has been already mentioned. It is composed of quartz, with a very little calc-spar, and is of a coarsely brecciated character, much of it consisting of a net-work of small veins; its total breadth is forty feet. Openings which have been made upon it where it is crossed by McIntyre's River, on this lot, do not appear to have brought to light any kind of ore. Its course is here N. 50° E. (mag.) with an underlie to the S.E. of about 10° from the perpendicular. Being harder than the sandstones and shales of the country, it forms a small ridge, which is rendered conspicuous by its white color. Mr. Macfarlane describes a vein having the same character, width and course on Shangoniah Island, in front of Wood's location, (*Can. Nat.*, Dec. 1869, p. 461.) A vein of about the same breadth, consisting of calc-spar and barytes, with some specks of galena, occurrs on one of the small islands lying to the south-east of Pie Island, and was examined by two of our party. I was unable to visit the Lead Hills location, which is situated in the township of McTavish, at the distance of three or four miles west of the shore of Black Bay, and where a rich vein of lead ore occurs in a pale red indurated marl. In a report on this location, Professor Chapman says: "The vein consists of a gangue of quartz, with enclosed portions of wall-rock, and some heavy spar, etc., carrying a very strong lode of intermixed copper-pyrites and galena. The vein itself appears to average about ten feet in width; but, at present, it is to a great extent uncovered. The copper-pyrites and galena, although scattered more or less throughout the vein, run principally in a solid lode, of at least four feet in width. The course of the vein is about N. 65° E.; and so far as this can be determined in the present undeveloped state of the vein, the dip, or underlie, is toward the southwest, at an angle of about 80°." In one sample he found 8.10, and in another 11.62 per cent. of copper. One of these samples also yielded 47·56 per cent. of lead. Professor Chapman's discovery of gold and silver in this ore has been already referred to. During our stay at Fort William, a number of blocks of solid ore were brought from the location, some of which would weigh several hundred pounds. A sample broken off one of them yielded, by Mr. Broome's analysis, 38.35 per cent. of lead, and this, by cupellation, gave nearly one ounce of silver and

Lead mine.

half an ounce of gold to the ton of lead. Several other lead-bearing veins are reported as occurring in this neighborhood. A quartz vein, about one foot wide, and carrying a considerable quantity of galena, has been noticed in the *Geology of Canada*, page 690, as cutting the granitic gneiss of Granite Island in Black Bay.

On the east side of Lake Nipigon, Mr. De La Ronde reports a vein, from which he has taken good specimens of galena on the Poplar Lodge River, at a few miles from its mouth. On the west side of the lake an Indian shewed me a specimen of drusy white quartz, holding galena, which he said he had broken from a vein about four inches wide, running north and south, on the Gull River, below Cedar Lake; three and a half days journey, by canoe, from Nipigon House. He also said that an ore, which I judged from his description to be copper-pyrites, was found at the same place. Small specks of galena were met with in a loose fragment of greenish marly limestone at the first rapid on the Poshkokagan River.

Copper ores.

Copper.—The deposits of native copper occurring among some of the higher members of the Upper Copper-bearing series, so far as they are known, are fully described in the *Geology of Canada*, pages 71 and 75. Many of the veins which are found cutting this series in the Thunder Bay region, and which have been noticed in the preceding paragraph, also contain copper-pyrites, but none of them require further description. A vein occurring just behind Red Rock, but which I was unable to examine, is said to hold vitreous copper ore.

On the east side of Lake Nipigon, Mr. McKellar reports that the diorites and dioritic slates on the lake shore, on each side of Poplar Lodge, are traversed by a great number of quartz veins, carrying copper-pyrites, with smaller proportions of purple ore and copper-glance; and he thinks that rich copper lodes may be discovered in this vicinity. Small quartz veins, or beds, carrying copper-pyrites, have been already mentioned as existing upon a small island in Humboldt's Bay. The Indians report two veins, one of a white, and the other of a reddish color, as traversing a high island in Ombabika Bay, but none of those of our party who visited the island, observed them.

Copper was said to have been discovered near the Hudson Bay Company's establishment at the mouth of the Wabinosh River, but we did not succeed in finding it. A vein containing amethyst is reported to occur on the south branch of the Wabinosh River, at a point lying one and a half day's journey, by canoe, from Nipigon House.

Silver.—This metal has now been discovered in the native state or in the form of silver-glance, in at least seven different localities in the Thunder Bay region, the veins in most cases belonging to the north and south

Silver ore.

set. The silver-bearing vein of Prince's location is described at page 76 of the *Geology of Canada*.

Wood's location.

Last summer Mr. Macfarlane, agent of the Montreal Mining Company, obtained a quantity of silver ore from a vein on the Jarvis location. The same gentleman has fully described the silver-bearing vein of Wood's location in the *Canadian Naturalist*, 1868-70. The portion of the vein at present worked is upon Silver Islet, about one mile from the main shore of Thunder Cape. "It has a width of about twenty feet on the north side of the island, and to the southward divides into two branches, each seven or eight feet wide. The course of the vein is N. 32° to 35° W., and it dips to the eastward at an angle of about 8°." The ore is a mixture of native silver and silver-glance in a gangue consisting mainly of calc-spar and quartz, but holding also small quantities of galena, blende, iron and copper pyrites, graphite, cobalt-bloom, nickel-green, and a mineral containing arsenic, nickel and silver, which Mr. Macfarlane thinks may be a new species. The thickness of the rich part of the vein varies from a few inches to two feet, and it keeps to the east or hanging side of the vein." Up to the month of April of the present year, the value of the silver taken from the crop of the lode on the islet, or rather in the shallow water beside it, since its discovery in the summer of 1868, is supposed to amount to about $25,000.

Thunder Bay Mine.

The lode at the Thunder Bay silver-mine, which has been referred to on page 326, consists of a network of small quartz veins, occupying a breadth of six or seven feet, and runs N. 34° E., with a slight underlie to the north-westward. Two shafts have been sunk upon it, each to the depth of about seventy feet. Between them, part of the lode consists of a vein stone of white granular quartz, about one foot thick, and in this most of the silver has hitherto been found. It occurs principally in the form of irregular branching filaments of the native metal, disseminated in the quartz in isolated bunches, in which the silver often forms more than ten per cent of the mass. One of these bunches, which was removed during our visit to the mine, weighed upwards of one hundred pounds. Silver-glance is also present in small quantities; the largest piece of this mineral which I saw would weigh about two ounces. The silver appeared to be most abundant in the upper fifteen feet, where the wall-rock, as mentioned on page 326, differs from that farther down. In the lower part of the mine silver-glance only has been found.

The workings at the Shuniah mine, two miles west of the last, being full of water, could not be examined; but from the description of Professor Chapman, it appears that the conditions here are similar to those at the Thunder Bay mine, except that the vein runs nearly east and west.

At the Silver Lake location, about four miles north of the head of

Thunder Bay, the silver occurs as small grains, in the native state, with dark colored blende, in a vein of quartz. Another locality of silver is on McKellar's Island, one of the small rocky group south-east of Pie Island. Here the metal occurs with blende, as in the last locality, but the veinstone is mostly coarse calc-spar.

Gold.

Gold.—The existence of gold, in a vein on Prince's location, is mentioned in the *Geology of Canada*, pages 76, 517 and 745, and some facts in regard to its occurrence in a vein on the Lead Hill's location are given on page 357, of the present report.

Manganese.—Many of the boulders and pebbles uncovered, in making the Red River Road, about half way from Thunder Bay to the Kaminitiquia, are coated with black oxide of manganese.

Salt springs.

Salt.—The brine-spring at the head of the first rapid on the north branch of the upper section of the Black Sturgeon, is described on page 335, and another has been mentioned as occurring half a mile below the first rapid on the Poshkokagan. My Indian guide informed me that a third was to be found near a small clear-water brook on the west side of Gull Bay, about a mile north of the mouth of the Kobitotiquia River. A handful of salt was obtained by boiling down about two quarts of the water of the first mentioned spring, but having afterwards become accidentally wet, the greater part of it was dissolved away, so that any analysis of what remained would be of no value.

Limestone.

Limestone.—Rock fit for burning into lime can probably be obtained among the beds of division 8, page 319, near the eastern line of Wood's location, as well as from the calcareous strata on the east side of Nipigon Harbor; and perhaps also among the dolomite bands of the lower group, which have been described as occurring at the head of Thunder Bay, near the Thunder Bay silver-mines, and in the southern part of the township of McIntyre. The calcareous spar of some of the larger veins on the coast and islands between Pigeon River and Fort William may also prove valuable for the same purpose.

The specimens of the limestone from the north-east shore of the Chief's Bay, Lake Nipigon, which have been analysed by Mr. Broome, contain 38.5 per cent of insoluble silicious clay, which is probably in so large a proportion as to prevent the rock, when calcined, from forming, by itself, a good cement. The soluble part is a magnesian carbonate of lime, of which one quarter is carbonate of magnesia. In a specimen from the similar rocks at Cook's Point, the insoluble clayey portion equalled only 29.6 per cent., and, as in the other case, one fourth of the soluble part consisted of carbonate of magnesia.

Brick clay.

Brick Clay.—The stiff red clay which is so largely developed in the valley of the second reach of the Kaminitiquia River would probably make very good common bricks. It is free from lime, but holds much iron, and is therefore fusible. The lighter colored stratified clay of the lower reach is also apparently suited for the same purpose, as well as the plastic clays which have been described as occurring in the valleys of most of the rivers entering Lake Nipigon.

Building stones.

Building Stone.—Among the stones most suitable for building purposes, met with in the region explored, may be mentioned the sandstones occurring in the peninsula between Thunder and Black Bays, along the lower part of the Black Sturgeon River, east and south of Black Sturgeon Bay on Lake Nipigon, at Nipigon House, and on the southern peninsula of Ombabika; the limestone of Chief's Bay and Cook's Point; the feldspar-porphyry to be found along the shore from Nipigon House to English Bay; and some varieties of the common dark trap, in various parts of the region.

Roofing tiles.

Roofing Tiles.—The hard dark colored shales of the lower reach of the Kaminitiquia are supposed by some to be fit for roofing purposes, but owing to their want of strength, and their imperfect cleavage, they are but poorly adapted to such a use. On the east shore of Lake Nipigon, about three miles north of the Poplar Lodge River, Mr. McKellar reports, a band of dark colored slate with very perfect vertical cleavage, which he thinks might answer for a roofing material.

RAILWAY ROUTE AND COLONIZATION.

Railway route.

In the special report on the practicability of a railway through the Nipigon country, which I had the honor of addressing to you on the 22nd of February last, a general description was given of the route which we discovered, and its advantages. Our map of the district having been compiled since that time, I am now enabled to indicate this route upon it. It crosses the Nipigon at the outlet of Lake Helen, where the river is narrow, and the banks, consisting of boulder-drift, are from thirty to forty feet high. From this intersection it follows down the western side of Nipigon Harbor to a point about three and one-half miles south of Red Rock, where it turns westward through the level pass leading to Black Sturgeon River. This river would be crossed at some point below Eshquanonwatan Lake. Continuing north-westward, the route could pass either east or west of Pike and Cyclas Lakes, or between them. Further on, it would cross the Poshkokagan and the Kabitotiquia not far from Chief's Bay, at a very moderate elevation above Lake Nipigon. Between the latter stream and the valley of the Gull River the country is level. The general grade in the above distance—about 100 miles—is very slight; Lake Nipigon, according to the observations which I have given in a previous part of this

Railway route. report, being only a little more than 300 feet above Lake Superior; while along the above route there appear to be no difficult local grades. Besides the rivers to be crossed, the only obstruction which I observed is a small point of rock on the west side of Nipigon Harbor, just before turning west towards the Black Sturgeon River. This consists of a cliff of red marl, capped by trap, rising from the margin of the lake. The water at its base is very shallow, some of the stones rising above the surface, and sufficient of the rock to form an embankment could be easily dislodged from the jointed columnar trap above. The whole length is only from fifty to one hundred yards.

A practible route for a railway may possibly be found by following up the west side of the Nipigon River, and the valley of Portage Brook, and thence crossing to the Black Sturgeon River in the neighborhood of Eshquanonwatan Lake.

Waggon-road. For the immediate purpose of colonizing the shores of Lake Nipigon a waggon-road might be constructed from Camp Alexander on the Nipigon River, across to South Bay on the lake, the distance being not much over twelve miles. From this point, vessels on the lake would have access to upwards of 580 miles of coast-line, exclusive of the islands, many of which are habitable.

I have the honor to be,

Sir,

Your very obedient servant,

ROBERT BELL.

Montreal, May 23rd, 1870.

POSTSCRIPT

BY

SIR W. E. LOGAN, F.R.S.,

ADDRESSED TO

ALFRED R. C. SELWYN, Esq.

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

MONTREAL, 1st *July*, 1870.

SIR,—Having been absent from Canada between the end of March and the latter part of June, I had not, until lately, an opportunity of perusing Mr. Robert Bell's Report on the Nipigon country. His explorations there were entered on by my instructions, and prosecuted while I was still director of the Geological Survey, and as I thus feel myself responsible for his work, I am desirous of making a few remarks regarding it.

R. Bell's report.

Mr. Bell's Report was printed, and Mr. Bell had started on his present season's investigations, before my return to Canada, and my remarks must therefore appear as a postscript to the General Report you are about to transmit in a printed form to the Government.

The explorations of Mr. Bell and his party have greatly extended our knowledge of the country to the north of Lake Superior, both in a topographical and a geological point of view, and important results are likely to follow. These gentlemen have displayed much perseverance in going over a large extent of ground, and determining its main features, the principal one of which, geographically, is the large lake which empties into Nipigon Bay. On being mapped to scale, however, the area of this lake does not appear to be by any means so great as was at first anticipated, nor does its magnitude seem to have been understated by previous explorers.

T. W Herrick plan.

On a plan of the north shore of Lake Superior, resulting from Mr. T. W. Herrick's explorations, and published in the Report of the Crown Land Commissioner in 1863, the estimated dimensions of the lake are said to be between 100 and 200 miles in length, by about sixty miles in breadth. With the aid of this plan, but limiting the dimensions of the lake, by geo-

Map compiled by R. Barlow.

graphical features reprinted on a map of Lake Superior published in 1832 by the Society for the Diffusion of Useful Knowledge, Mr. R. Barlow, topographical draughtsman to the Geological Survey, several years ago came very near the truth both as to the size and position of the lake, in delineating it on the map compiled by him and published in 1866, on the scale of twenty-five miles to the inch, for the geological purposes of the Survey. As represented by Mr. Barlow, Lake Nipigon is very little different in size from that which the protraction of Mr. Bell's measurements makes it now.

Bell's map a sketch.

Considering the great extent of the shore-line of Lake Nipigon and the comparatively short time employed in surveying it, there must unavoidably be a great number of parts which have been only approximatively determined; the map must therefore for the present be considered no more than a sketch, of which the details may be improved hereafter as occasion may serve.

Height of Lake Nipigon over Lake Superior.

At the time of my departure in March the height of Lake Nipigon above Lake Superior was estimated by Mr. Bell at about 150 feet, and it was so represented by him in various lectures and in conversations with members of parliament and others; but I now find it stated in the Report to be 313 feet. In the absence of Mr. Bell it is difficult for me to imagine the reason of this difference. Two aneroid barometers were supplied him for the purpose of determining heights, and the greater height is that resulting from the readings of the instruments for the three principal ascents, amounting to 263½ feet, with an estimated height of 49½ feet for the remainder, consisting of thirteen separate slopes. The height as now given much more nearly approaches that published by Mr. S. J. Dawson, founded on the observations of Mr. Armstrong, and an apology is due to all those who may have been misled by Mr. Bell's mistake.

Unconformable trap.

In the geological branch of his investigations, Mr. Bell has carried the Upper Copper-bearing rocks of Lake Superior much farther north than they were previously determined. He appears to have ascertained that the great trappean overflows between Pigeon River and the Battle group of islands, rest uncomformably upon the outcrop of the slates and the succeeding variegated sandstones, conglomerates and marls through which they have been poured, and occupy a gap or depression in the range of the Laurentian and Huronian rocks.

Question of Triassic age.

On lithological grounds alone Mr. Bell expresses the opinion that these volcanic products are of Triassic age. This opinion was long ago insisted on by Mr. Marcou, and no doubt lithological character is entitled to weight, when structural evidence cannot be brought to bear; but I am desirous of guarding you against the supposition that there is no such evidence in the present case, tending to carry the age of these rocks in a contrary direction. An allusion has already been made to this evidence in the *Geology of Canada*, p. 85.

Evidence of Lower Silurian age.

Sudden change of strike E. side of L. Superior.

From the western extremity of Lake Superior the trappean strata appear to strike eastward with considerable regularity for 300 miles, until they pass Michipicoten Island and reach the eastern coast. Here the strike suddenly changes to a bearing at right angles to its previous course, with an upward slope to the eastward sufficiently rapid to bring an estimated thickness of at least 10,000 feet to the surface at Mamainse, in no very great distance across the measures. This sudden change of strike, and its accompanying phenomena, have much the aspect of a great dislocation, or it may be a great undulation. Its effects are apparent for nearly a hundred miles along the east coast of the lake, and at the extremity of Gros Cap, are visible to within a few miles of the base of a series of Lower Silurian fossiliferous limestones and shales. These Lower Silurian rocks, in a comparatively undisturbed condition, strike across the bearing of this great disturbance, and are followed by a series of palæozoic strata, including Middle and Upper Silurian, Devonian and Carboniferous, belonging to the Michigan trough, all in a like condition, and apparently free from trappean intrusions.

If the trappean rocks of Lake Superior were post-Carboniferous, it would be a startling fact that a series of rocks older than the traps should cross the line of such a great disturbance in these, and approach so near, without the smallest effect being produced upon the inferior strata; and this alone would challenge a very rigid examination before allowing the traps to be of Triassic age.

Sault Ste. Marie sandstones.

Birdseye and Black River formation.

Murray's distribution of sandstones.

According to the late Dr. Houghton, in his Report of 1840, as State Geologist of Michigan, sandstones are seen to rise at a low angle from beneath limestones near Nebish rapids. These limestones are fossiliferous, and are part of the Lower Silurian series to which allusion has just been made. They here lie in the strike of similar limestones, observed by Mr. Murray in 1860, on St. Joseph Island, where, as well as in an outlying patch on Campement d'Ours, dipping at the same low angle as before, they contain an abundance of well marked Birdseye and Black River fossils, and where they rest upon eighty feet of similar sandstones, which are supported by Huronian strata. There does not appear to be any reasonable doubt that these nearly horizontal sandstones belong to the same series as those at Sault Ste. Marie rapids, and that they extend to the foot of Gros Cap Mountain; passing thence to Point Iroquois, White-fish point and Isle du Parisien. To the eastward of this island Mr. Murray represents them in a narrow strip, leaning against the Laurentian gneiss at a moderate angle, and stretching seven miles along the south side of Goulais Bay; also as forming the township of Kars and the chief part of the promontory between Goulais and Bachehwahnung Bays. He represents the large island in the latter bay, and the coast to the north of it, as composed of them, with a conformable conglomerate beneath, while on the mainland amygdaloidal trap rocks appear beyond them in several places, resting on Laurentian gneiss and dipping westward at considerable angles. But in the neighbourhood of Ance aux Crêpes, on the south side of Mamainse promontory, older sandstones, in a disturbed condition, appear to be confusedly mixed up with the trap.

Macfarlane's section of Mamainse.

Mr. Macfarlane carefully examined the rock of Mamainse promontory for the Survey, in 1866, and in his Report to me, at pp. 132-137, will be found what he has said of them. He roughly measured by pacing the beautiful section, which I had previously estimated as at least 10,000 feet thick, and separating it into forty-nine described masses, he raises the whole volume to 16,208 feet, of which 2137 feet are conglomerates, the rest being various kinds of igneous rocks. After various descriptive details, regarding lithological peculiarities and the conflict of sedimentary and eruptive masses, Mr. Macfarlane says:—

Unconformable upper sandstones.

> "From what has been stated above it would appear that there is, at several points, evidence of the existence of a sandstone of greater age than the bedded traps and conglomerates, and it would appear not unreasonable to suppose that it belongs to the lower group of the Upper Copper-bearing series. You have, however, pointed out (Geology of Canada, p. 85) that there are extensive areas of almost horizontal sandstones on the east shore, whose indicated dip, and freedom from intersecting trap dykes "seem to support the suspicion that they overlie unconformably those rocks which, associated with trap, constitute the Upper Copper-bearing series." In confirmation of the opinion you have expressed, I have to report that at a point to the south of Pointe aux Mines, where the Mamainse series adjoins the Laurentian rocks, the lowest member of the former is unconformably overlaid by thin bedded bluish and yellowish-grey sandstones striking N. 50° E. and dipping 18° north-westward. The lowest layer is a conglomerate with granitic and trappean boulders, and a bluish fine grained and shaly matrix. It is about six feet thick, and is followed by thirty feet of thin bedded sandstones, some parts of which might yield good flagstones. Some of the surfaces of these are very distinctly ripple-marked. Above these come thin, shaly, rapidly disintegrating layers, in which are spheroidal concretions from five to ten inches in diameter. It is not possible to ascertain the total thickness of these sandstones, since they descend beneath the level of the lake. They are similar in lithological character to the sandstones which occur on the north side of Pointe aux Mines." *

These upper unconformable sandstones, there appears to me no reasonable doubt, are Mr. Murray's upper rocks from Mamainse to Gros Cap, and from Gros Cap to Nebish and Campment d'Ours; and it will thus readily be inferred from what has been said, that the reason why the tilted rocks of the Mamainse section, with a vertical thickness of over three miles, so suddenly disappear in their progress towards the Lower Silurian rocks to the south, is that they run under these unconformably.

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* For the relation of the Pointe aux Mines sandstones to 3,000 feet of trappean rocks there, see Geology of Canada p. 82.

In the northern peninsula of Michigan the Sault Ste. Marie sandstones appear to run along the south shore of Lake Superior, parallel with the fossiliferous limestones, for 150 miles, and gradually to turn to the southwestward from the neighbourhood of Marquette, as if following the rim of the Michigan trough to which they propably belong. Farther to the west, the rocks of Keewenaw promontory are represented as constituting an anticlinal form, having sandstomes on each side, with traps and conglomerates between. As will be seen from the following remarks by Professor Hall, a fossiliferous limestone equivalent to that of Campment d'Ours rests on the sandstone on the south side of the anticlinal.

Birdseye and Black River limestones on S. side of Keewenaw Point.

> "In 1846, Mr. C. C. Douglass discovered a fossiliferous magnesian limestone, resting upon sandstone, on the south side of Keewenaw Point in a line between the head of the bay and the mouth of Misery River. In 1848 or 1849 Messrs. J. W. Foster and J. D Whitney brought from this locality several species of fossils, which were submitted to the examination of the writer. The geologists of Michigan represent that the said sandstone at Grand Island is succeeded by a fossiliferous limestone, which is doubtless that of the Keewenaw Point. The character of the fossils from the locality on Keewenaw Point is such as to leave no doubt that the limestone is equivalent to the Bufflimestone of Wisconsin, holding the identical fossils, and representing the Birdseye and Black River limestones.*"

Fossills in the sandstone.

From the sandstone itself on the south shore of Lake Superior the only fossils obtained are a *Lingula*, † collected by Mr. Forest Shepherd in Tequamenen Bay, which Hall compares with a Calciferous species, and a *Pleurotomaria* § obtained by Mr. Murray near Marquette, which Mr. Billings compares with *P. Laurentina* of the Calciferous, but states to resemble also *P. aperta* of the Birdseye and Black River formation.

This concurrent testimony from the different observers of the south shore of Lake Superior, you will perceive all points one way, and apparently shews a wide extent of the sequence indicated near the exit of the lake. What the structural evidence north of the Lake may be, remains to be ascertained. Should the unconformable overlying trap support the supposed Upper Silurian rocks of the northern country, the north and south evidence would agree. Should the trap rest on the Upper Silurian rocks, the inference would be, unless the evidence on the south can be explained away, that there are two trappean periods, one Lower Silurian or pre-Silurian, and the other post-Silurian. But it is not the duty of the Geological Survey to predict what the age of the northern trappean rocks may be, but to investigate the evidence carefully and state it impartially.

I have the honor to be, Sir,
Your most obedient servant,
W. E. LOGAN.

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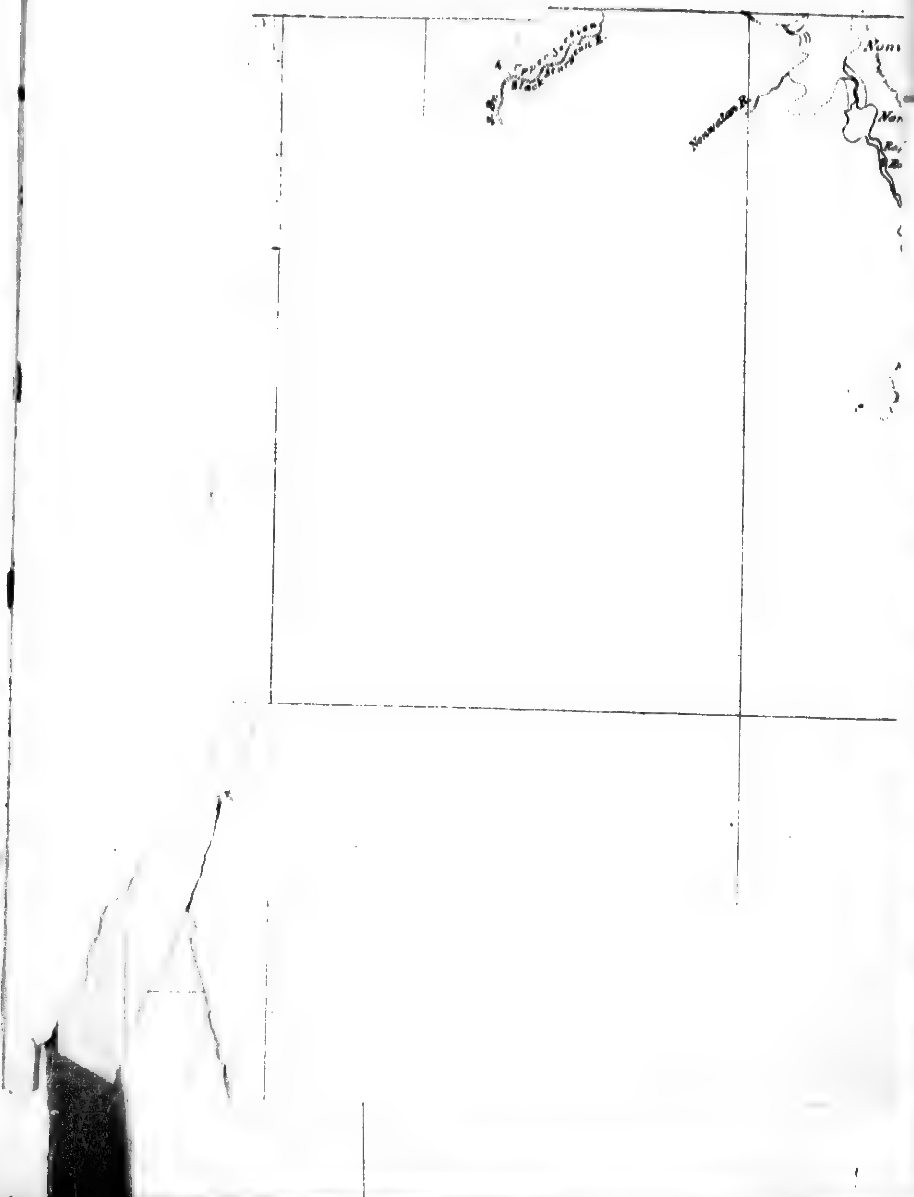
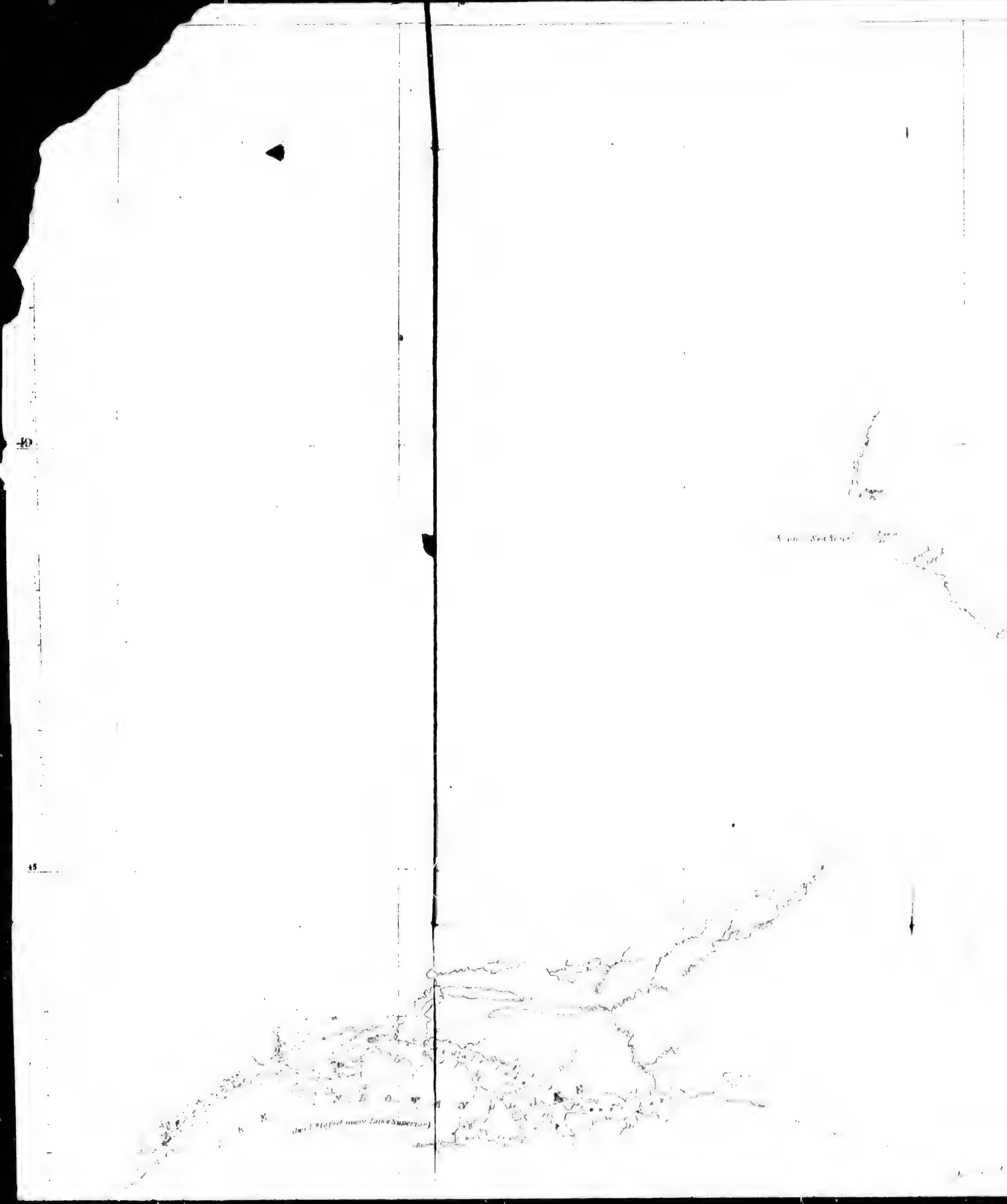
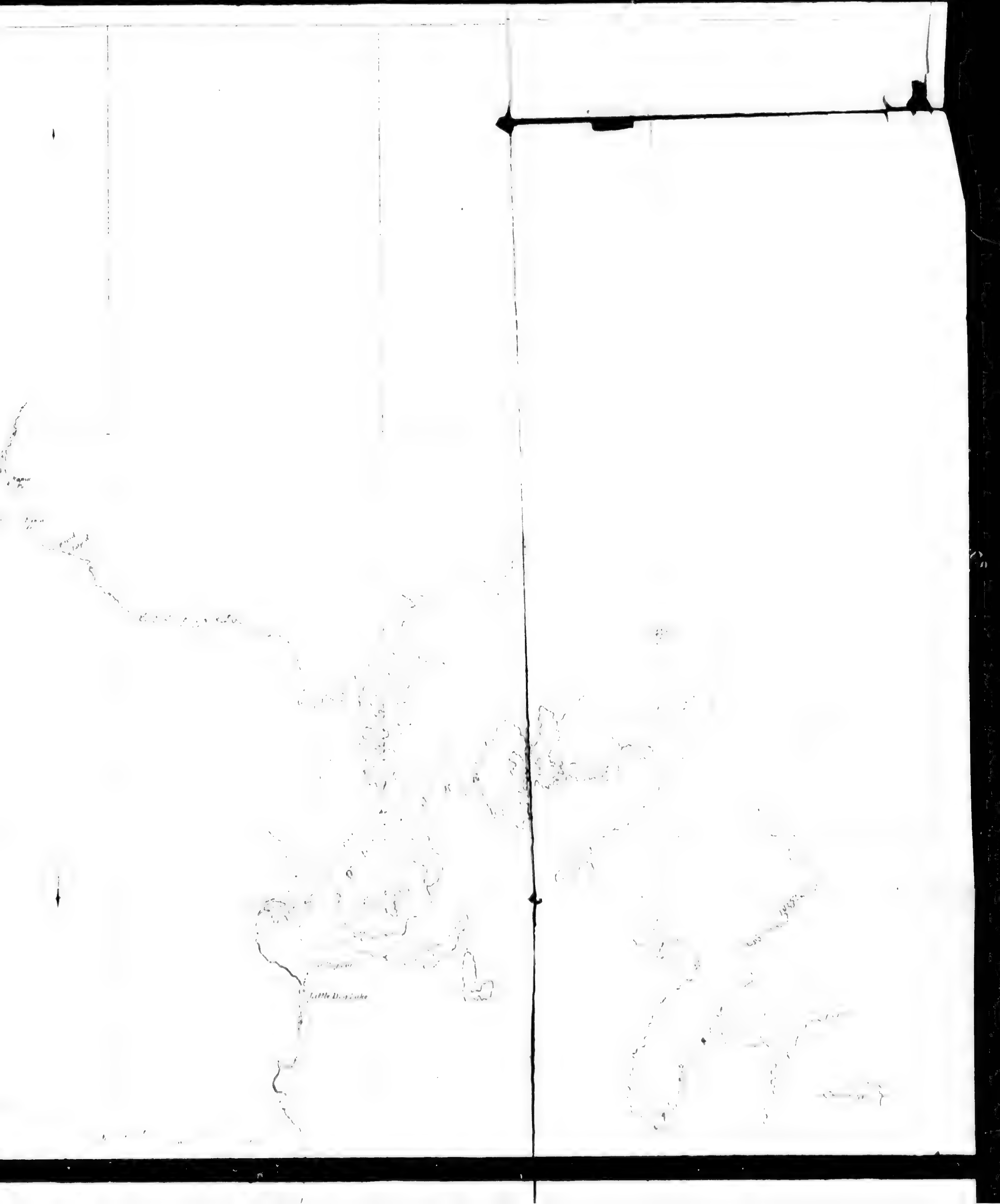
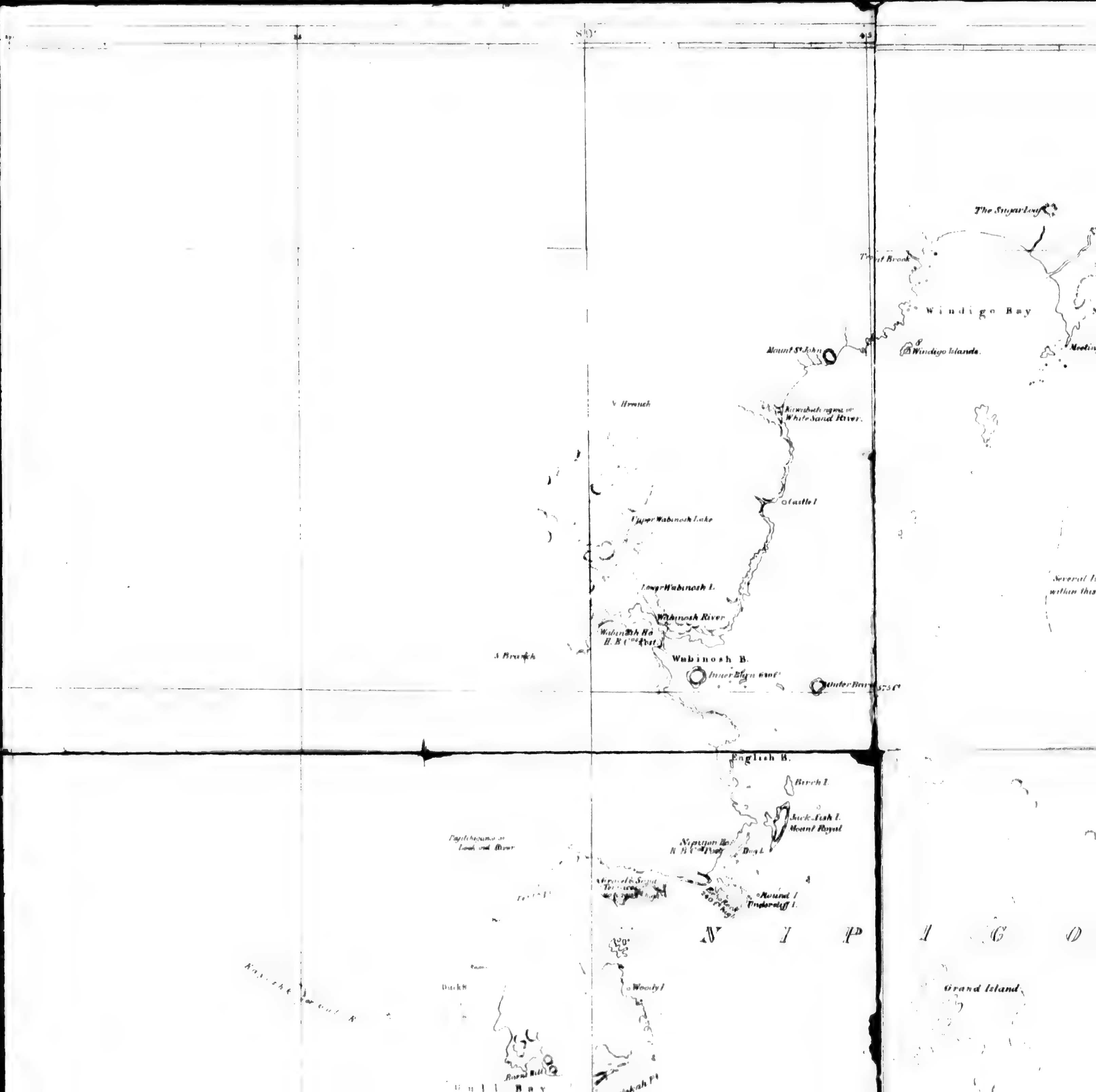
* Hall, Supplementary Notes on the Potsdam sandstone; XVIth Report of the Regents of the University of the State of New York, p. 215.

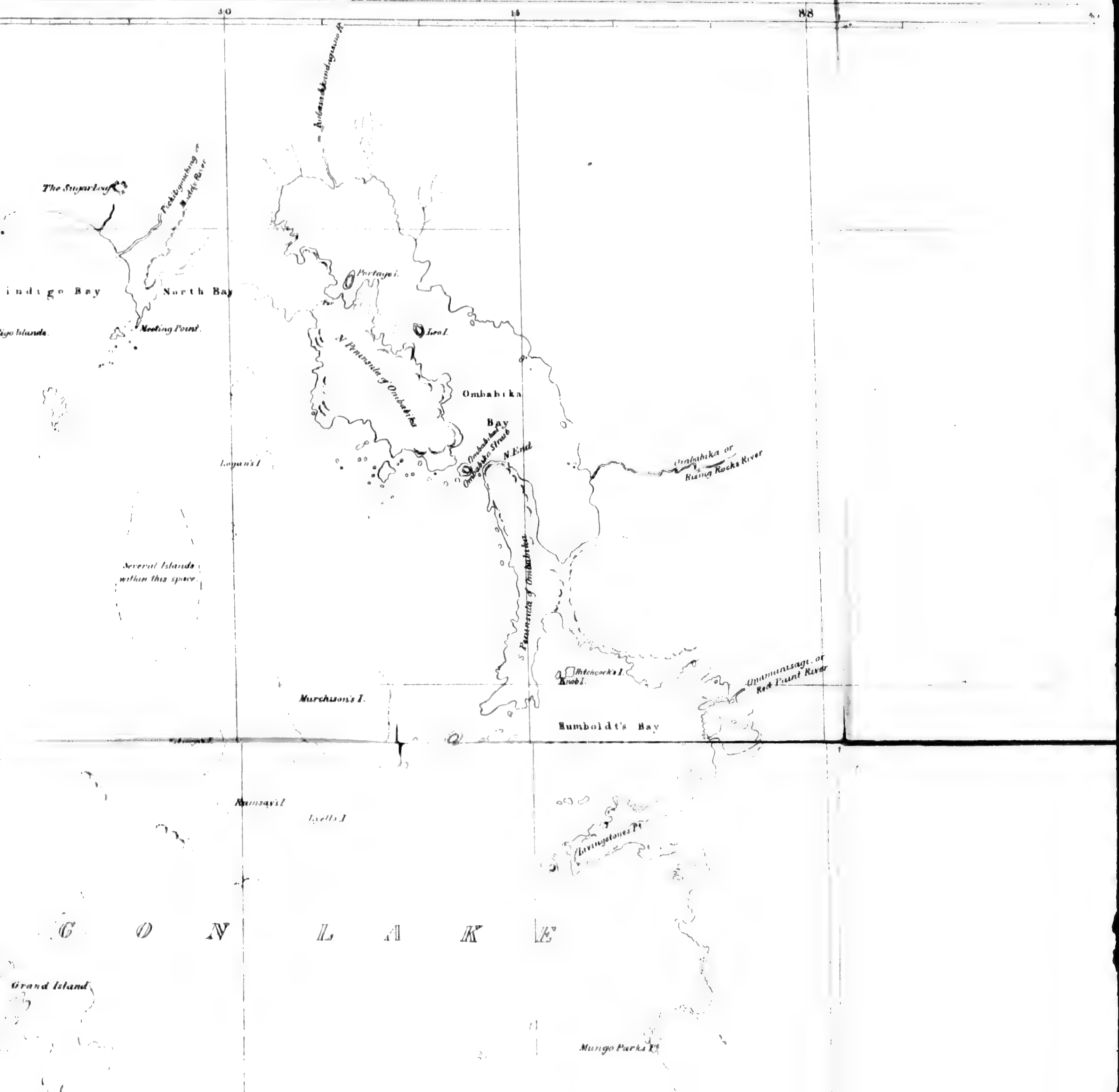
† Hall, same report, note p. 214. § Geo. Can. p. 86.

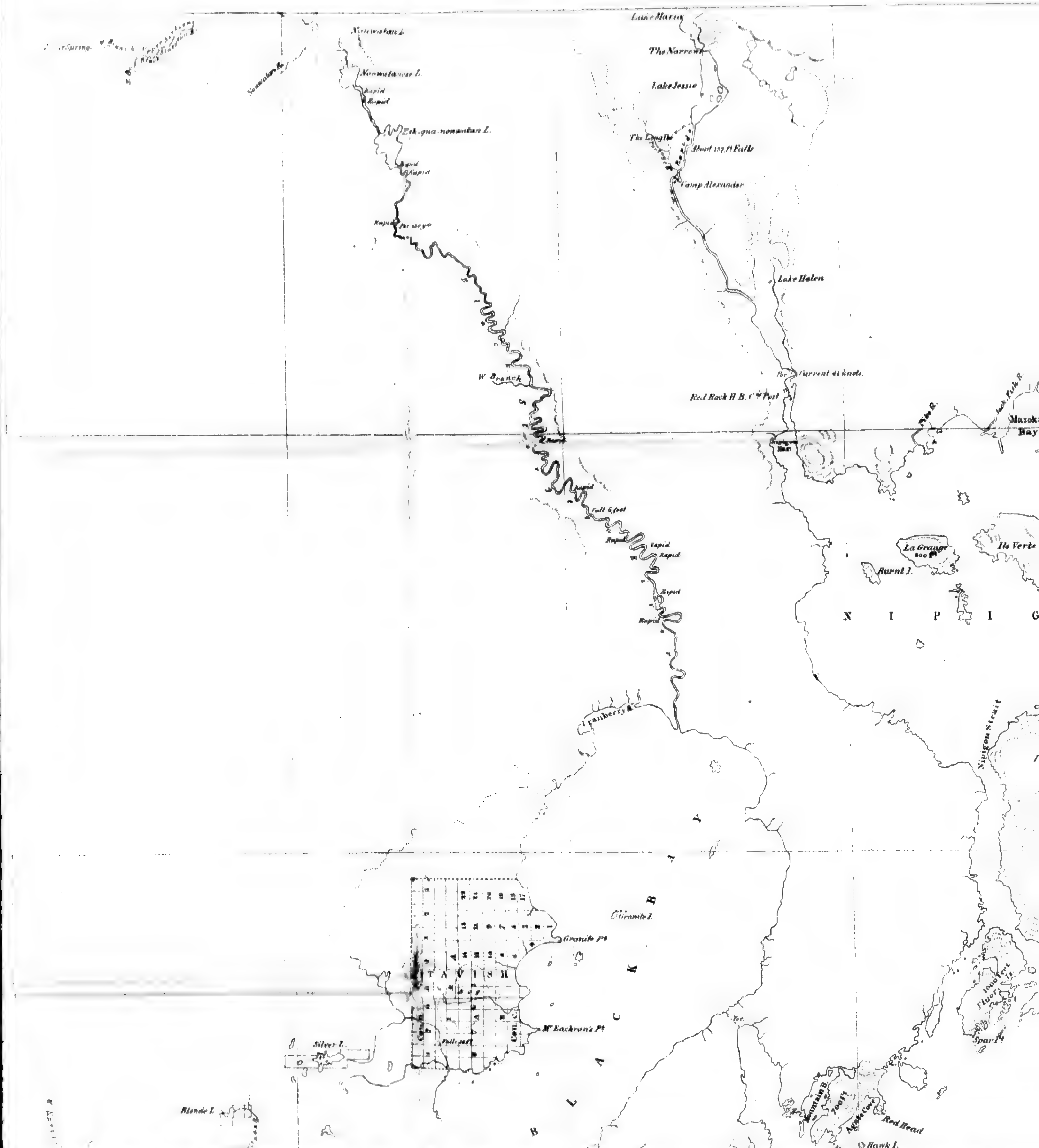

Upper Section
Black Sturgeon R.
S. B.
Nonwatan R.
Nom
Non
Rai
B

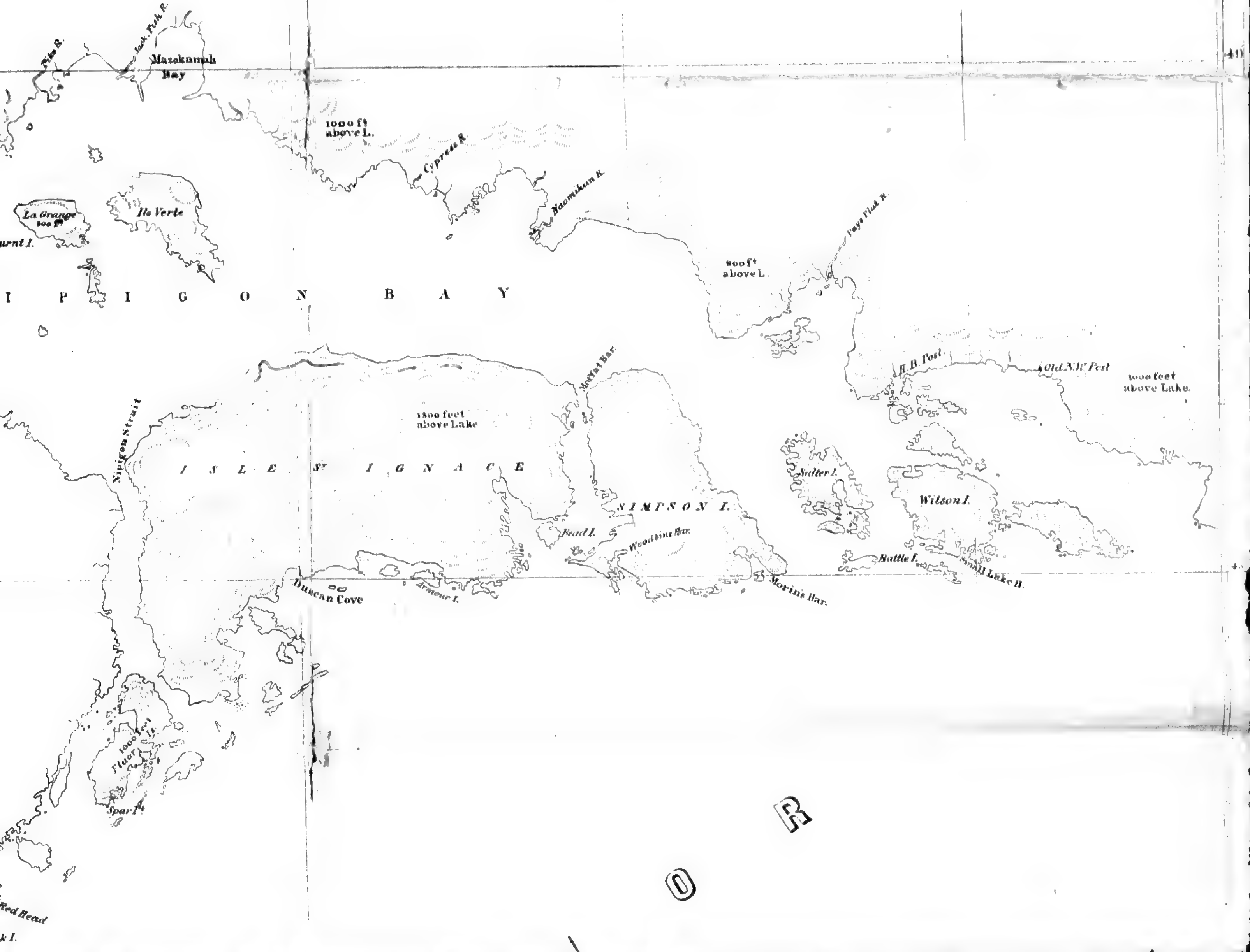

40
45
K E
(... feet above Lake Superior)


Little Dog Lake


89°
The Sugarloaf
Trout Brook
Windigo Bay
Windigo Islands.
8
Mount St John
Kawishatiagma or
White Sand River.
Castle I
N Branch
Upper Wabinosh Lake
Lower Wabinosh L.
Wabinosh River
Wabinosh Ho
H. B. C.o's Post.
S Branch
Wabinosh B.
Inner Barn 640 ft
Outer Barn 575 ft
Several Is
within this
English B.
Birch I.
Jack Fish I.
Mount Royal
Nipigon Ho
H. B. C.o's Post
Dog I.
Round I.
Undercliff I.
Paysleheguma or
Look out River
Woody I
Ducks
Burnt Hill
Gull Bay
N I P I G O N
Grand Island

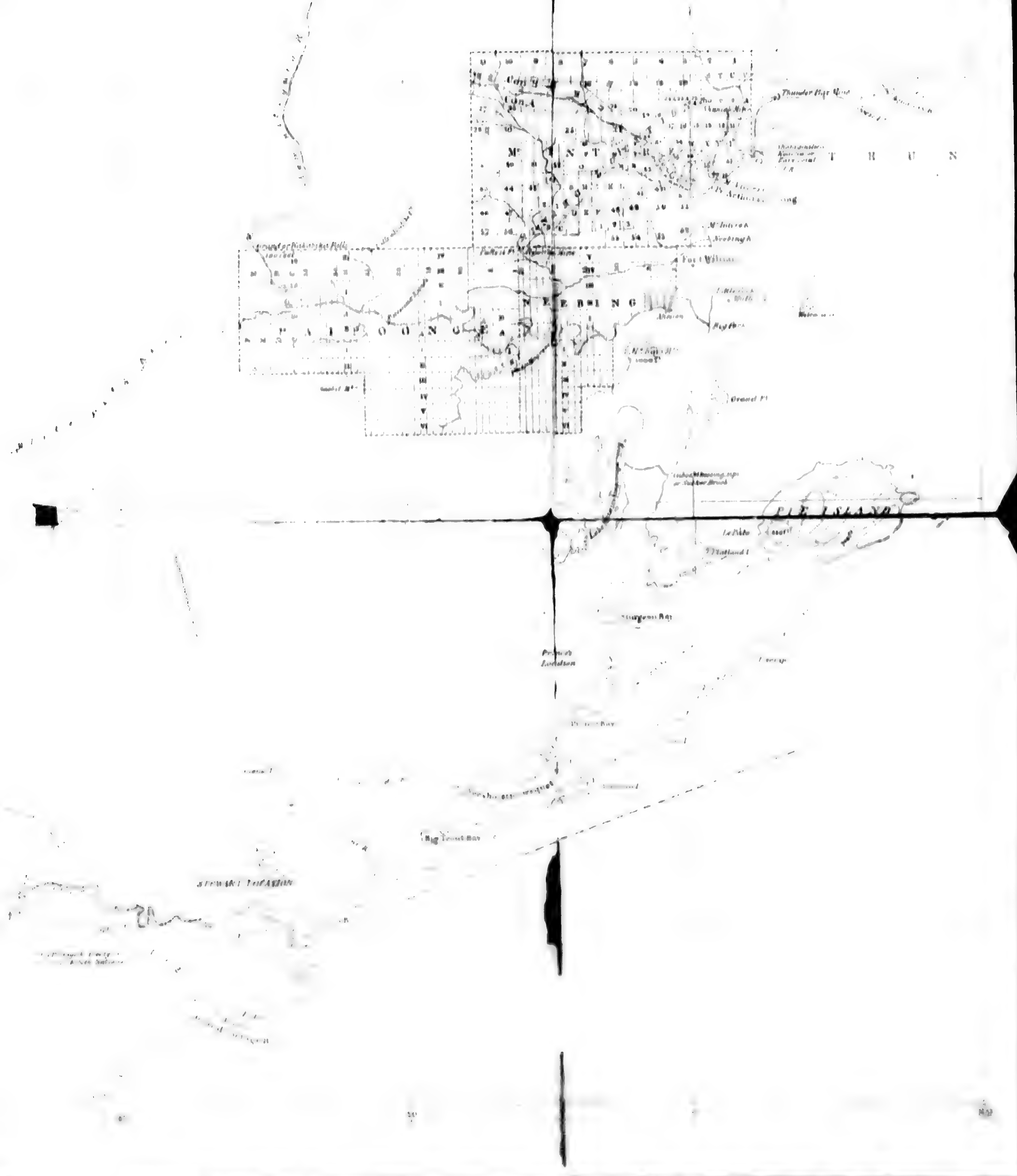

30
14
88
The Sugarloaf
Pickitiganaching or Baddy River
indigo Bay
North Bay
Meeting Point
igo Islands
Portage I.
Leo I.
N. Peninsula of Ombabika
Ombabika
Bay
Ombabika Strait
N. End
Logan's I
Ombabika or Rising Rocks River
Several Islands within this space
S. Peninsula of Ombabika
Hitchcock's I.
Knob I.
Omaminsagi or Red Paint River
Murchison's I.
Humboldt's Bay
Ramsay's I
Lyells I
Livingstones Pt
G O N L A K E
Grand Island
Mungo Parks Pt

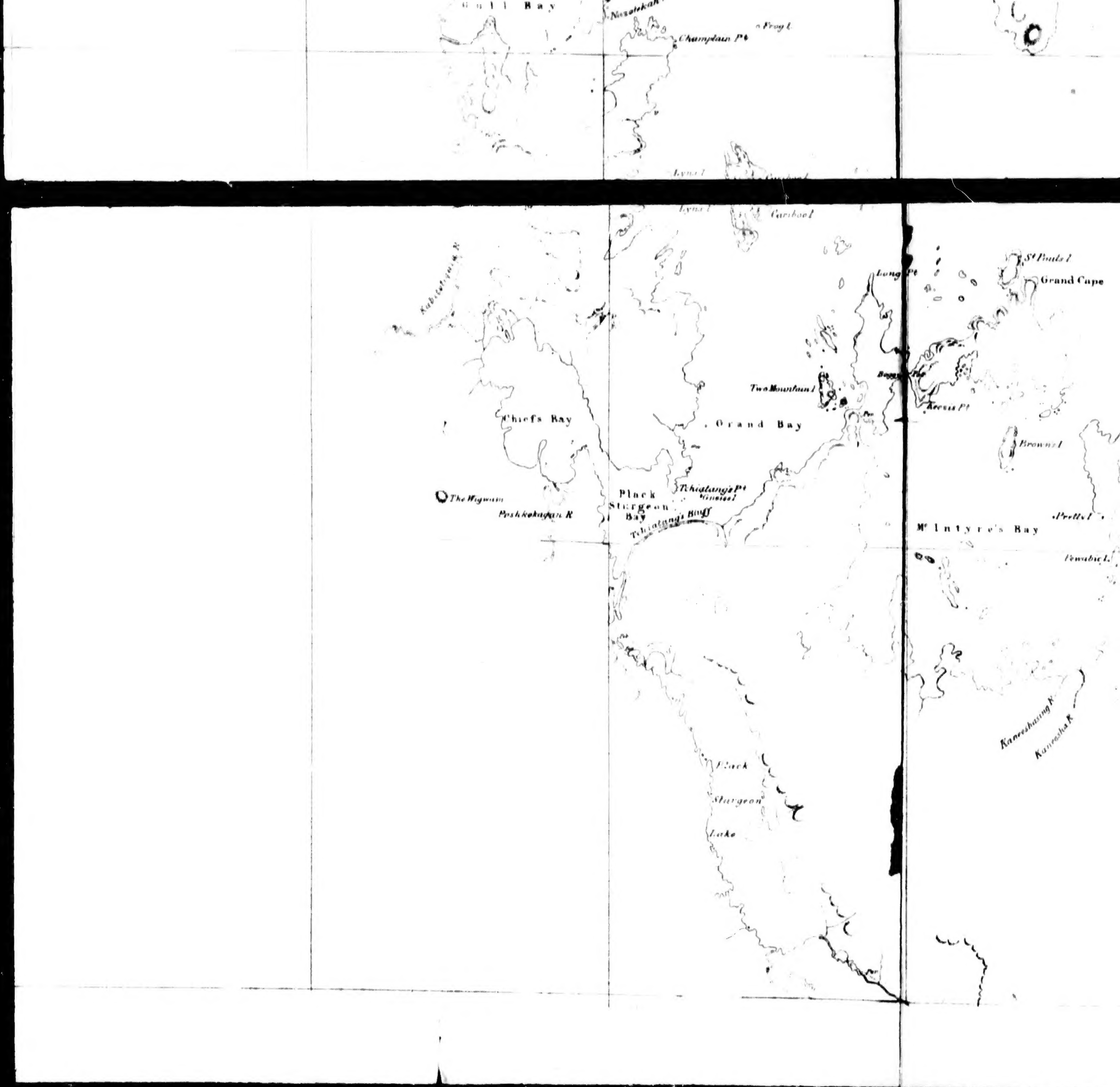

Lake Maria
The Narrows
Lake Jessie
The Long Ile
About 127 ft Falls
Camp Alexander
Lake Helen
Por.
Current 4 knots
Red Rock H. B. Co's Post
Nonwatan L.
Nonwatanose L.
Nonwatan R.
Rapid
Rapid
Esh-qua-nonwatan L.
Rapid
Rapid
Rapid
Pt 150 yds
W Branch
Rapid
Fall 6 feet
Rapid
Rapid
Rapid
Rapid
Rapid
Mazok
Bay
La Grange
800 ft
Ile Verte
Burnt I.
N I P I G
Nipigon Strait
Cranberry R.
B L A C K B A Y
Granite I.
Granite Pt
TAVISH
McEachran's Pt
Con. C
Silver L.
Blonde I.
Mountain B.
700 ft
Agate Cove
Red Head
Hawk I.
1000 feet
Fluor Is.
Spar Pt

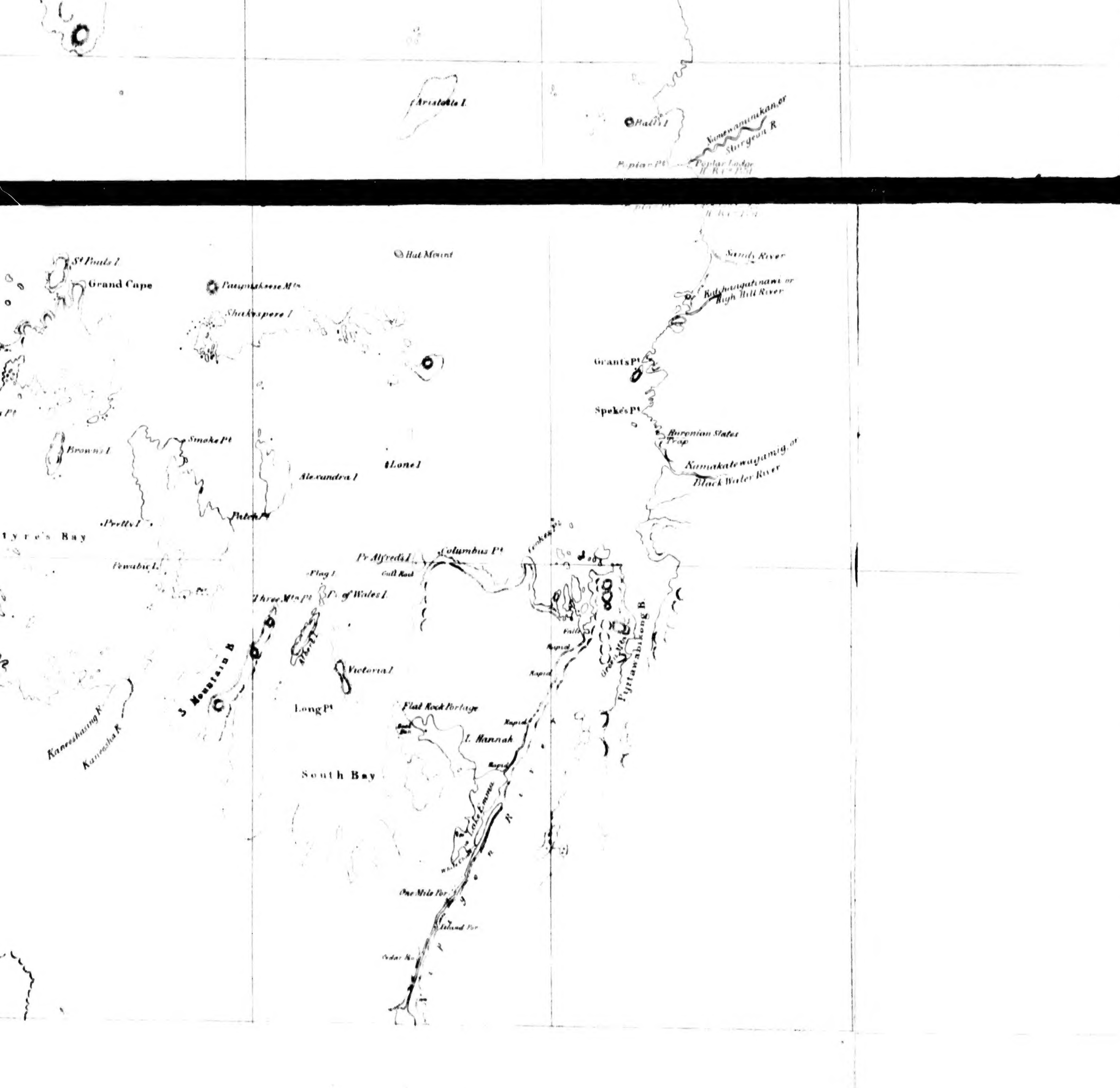


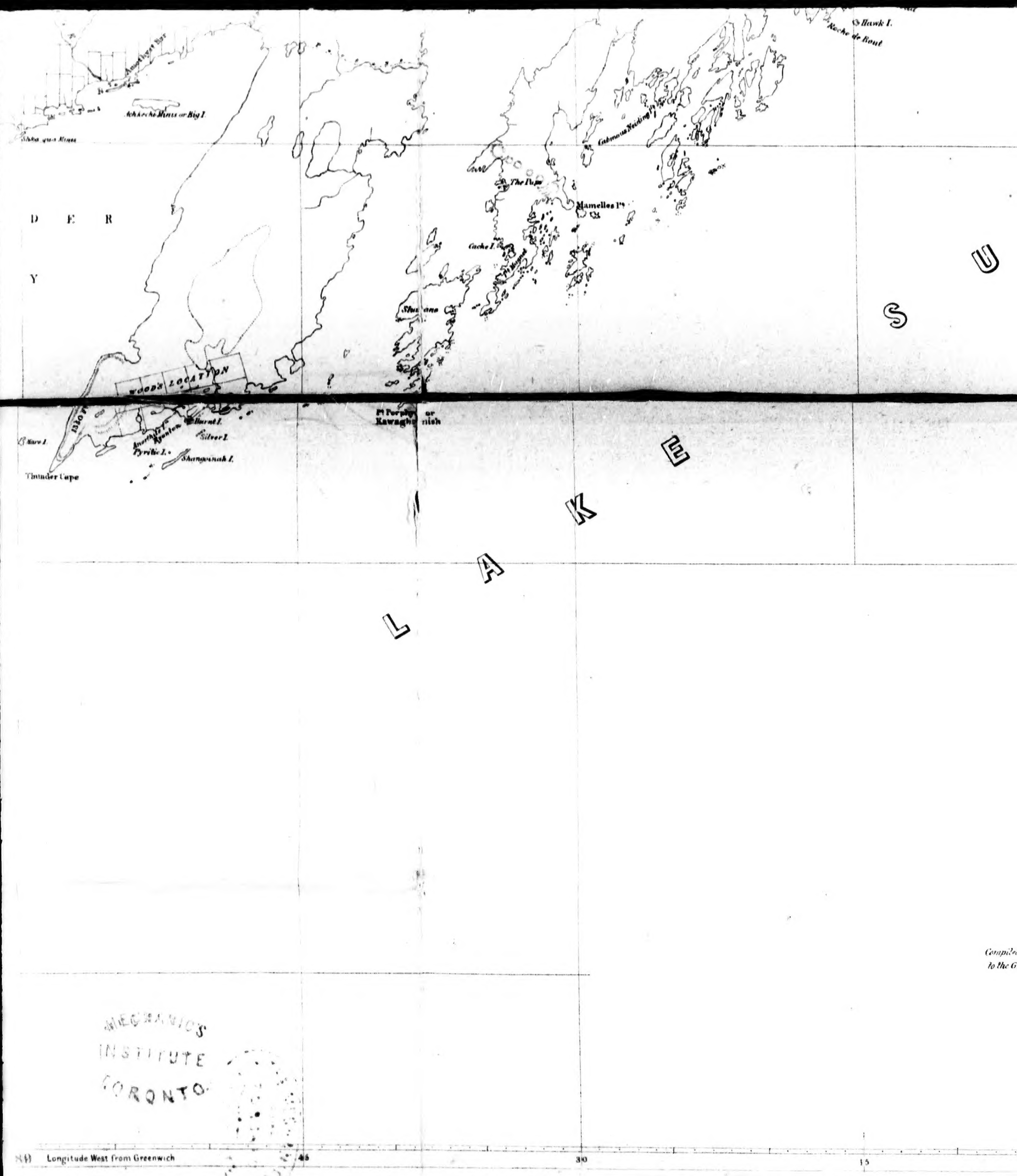
Pike R.
Jack Fish R.
Mazokamah Bay
1000 ft above L.
Cypress R.
Naomikan R.
Pays Plat R.
800 ft above L.
La Grange
800 ft
Ile Verte
urnt I.
IPIGON BAY
H. B. Post
Old N.W. Post
1000 feet above Lake.
Moffat Bar
1300 feet above Lake
Nipigon Strait
ISLE St. IGNACE
SIMPSON I.
Salter I.
Wilson I.
Fead I.
Woodbine Bar
Battle I.
Small Lake H.
Duncan Cove
Armour I.
Morin's Bar
1000 feet
Fluor I.
Spar I.
Red Head
k I.
R
O

30
48
Mountain Lake
Great ... Portage 2578 Yds
Fowl Lake
Fowl Por. 2000 Yds
Moose Por. 701 Yds
...ose Lake
Portage
90


Thunder Bay
T H U N
Fort William
N E E B I N G
P A I P O O N G E
McIntyre R.
Neebing R.
Grand Pt
PIE ISLAND
Sturgeon Bay
Big Trout Bay
STEWART LOCATION


Gull Bay
Nazotekah
Champlain Pt
Frog I.
Lynx I
Cariboo I
Lynx I
Cariboo I
Kabitotiquia R.
St Pauls I
Grand Cape
Long Pt
Two Mountain I
Keeses Pt
Chiefs Bay
Grand Bay
Browns I
The Wigwam
Poshkokagan R
Black Sturgeon Bay
Tchiatang's Pt
Gneiss I
Tchiatang's Bluff
Mc Intyre's Bay
Pretty I
Pewabic I.
Kaneeshaung R
Kaneesha R
Black Sturgeon Lake


Aristotle I.
Ball's I
Namewaminikan, or
Sturgeon R
Poplar Pt
Poplar Lodge
H. B. Co's Pst
St Pauls I.
Grand Cape
Paupmakseese Mts
Hat Mount
Shakespere I
Grants Pt
Spekes Pt
Sandy River
Katchewagatinawi or
High Hill River
Huronian States
Trap
Kamakatewagamig, or
Black Water River
Smoke Pt
Browns I
Alexandra I
Lone I
Patch Pt
Pretty I
tyre's Bay
Pewabic I.
Pr Alfreds I.
Columbus Pt
Cookes Pt
Flag I
Gull Reef
Three Mts Pt
Pr of Wales I.
Albert I
Victoria I
3 Mountain R
Long Pt
Kaneeshasing R
Kaneesha R
Falls
Rapid
Rapid
Rapid
Rapid
Pyjtawabikong R
Flat Rock Portage
L. Hannah
South Bay
Lake Emma
R
One Mile Por
Island Por
Cedar Ro



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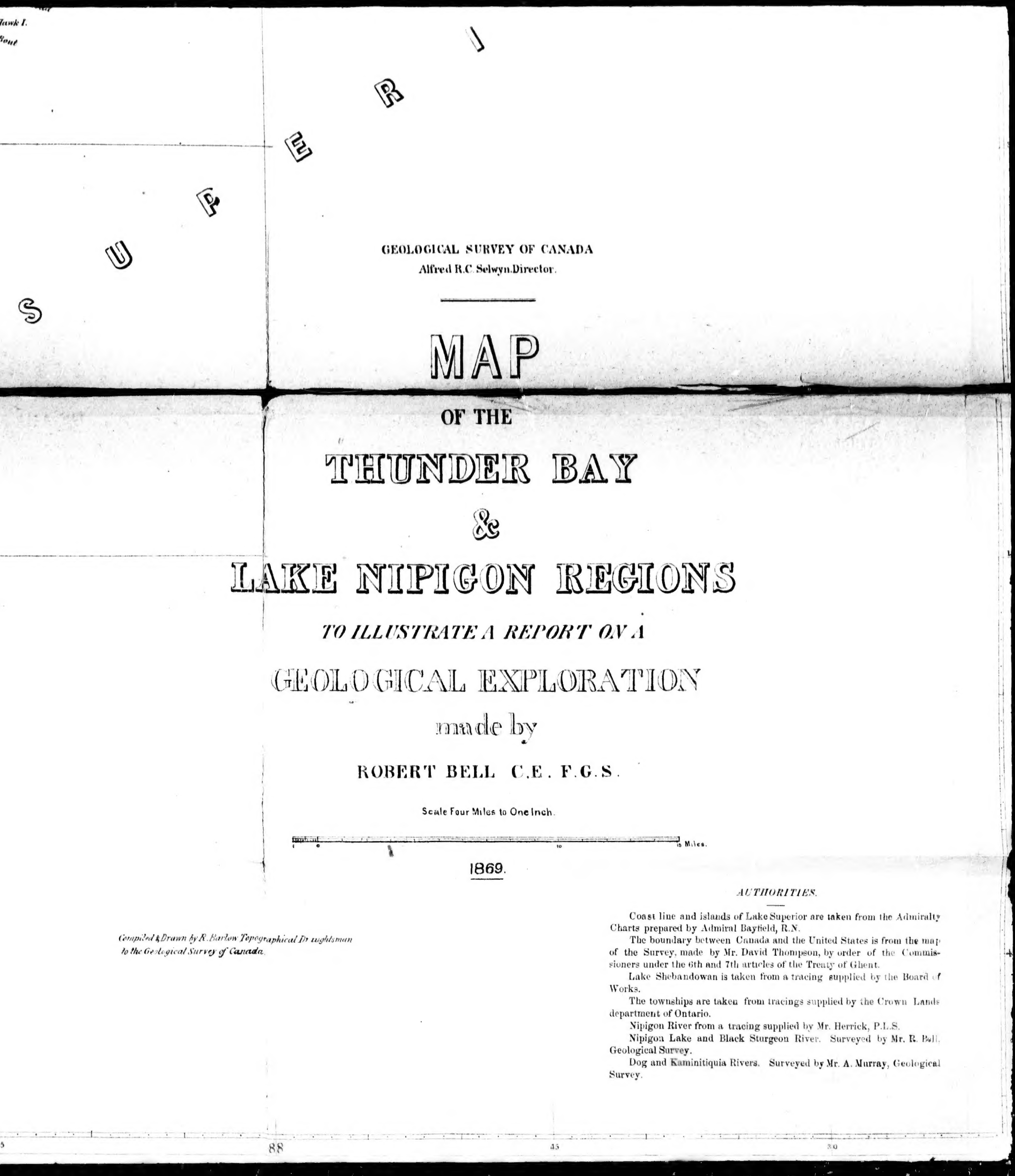
MECHANICS' INSTITUTE TORONTO



GEOLOGICAL SURVEY OF CANADA
Alfred R.C. Selwyn.Director.

MAP
OF THE
THUNDER BAY
&
LAKE NIPIGON REGIONS
TO ILLUSTRATE A REPORT ON A
GEOLOGICAL EXPLORATION
made by
ROBERT BELL C.E. F.G.S.

Scale Four Miles to One Inch.

1869.

Compiled & Drawn by R. Barlow Topographical Draughtsman to the Geological Survey of Canada.

AUTHORITIES.

Coast line and islands of Lake Superior are taken from the Admiralty Charts prepared by Admiral Bayfield, R.N.

The boundary between Canada and the United States is from the map of the Survey, made by Mr. David Thompson, by order of the Commissioners under the 6th and 7th articles of the Treaty of Ghent.

Lake Shebandowan is taken from a tracing supplied by the Board of Works.

The townships are taken from tracings supplied by the Crown Lands department of Ontario.

Nipigon River from a tracing supplied by Mr. Herrick, P.L.S.

Nipigon Lake and Black Sturgeon River. Surveyed by Mr. R. Bell, Geological Survey.

Dog and Kaminitiquia Rivers. Surveyed by Mr. A. Murray, Geological Survey.